Environmental health risk perceptions and protective actions

A mixed-method study of new mothers in Ontario, Canada

by

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Thesis submitted to
The Faculty of Graduate and Postdoctoral Studies
In partial fulfillment of the requirements for the degree of
Master of Arts in Geography

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ABSTRACT

This thesis examines mothers' risk perceptions and protective actions as they relate to their children's environmental health. Children are more exposed and vulnerable than adults to environmental hazards, which have been found to be associated with numerous immediate and long-term negative health outcomes, due to physiological and behavioural factors. Despite the responsibility mothers typically bear as primary caregivers to their children, little is known about how they perceive and negotiate these risks in their day-to-day lives. To better understand mothers' perceptions and associated protective actions across socioeconomic and geographic contexts, a mixed-method approach was employed involving a quantitative telephone survey (n=606) in Peel Region and Ottawa Public Health Units and qualitative face-to-face interviews (n=15) in Ottawa. Risk perceptions were influenced by income and perceived control, and concerns ranged from chemicals in household products to outdoor air pollution. There was a commonly reported perception that mothers should automatically become more concerned and take protective actions once they have children. When financial or other barriers prevented mothers from taking direct action to reduce risks, such as switching to safer products or changing food habits, they may have relied on emotion-focused coping techniques to reduce feelings of concern, including choosing to ignore risk information. Mothers' information sources were examined to understand how risk information is best internalized; while the most common source of environmental health risk information was the Internet, many mothers expressed their mistrust in it and would have preferred to receive information directly from healthcare providers. This research contributes to the understanding of risk perception and protective action in a largely

understudied population and the findings have practical implications for risk management and communication strategies targeting pregnant women and new mothers.

RÉSUMÉ

Cette thèse examine les perceptions des risques et les mesures de protection adoptées par les mères en fonction de la santé environnementale de leurs enfants. Les enfants sont plus exposés et vulnérables aux risques environnementaux que les adultes. Ces risques sont associés à plusieurs problèmes de santé ayant des effets à court et à long terme, en raison de facteurs physiologiques et comportementaux. Tandis que les mères sont souvent les soignants primaires de leurs enfants, peu est connu sur leurs perceptions et leur gestion de ces risques dans leur vie quotidienne. Pour mieux comprendre les perceptions et mesures de protection des mères selon les contextes socioéconomiques et géographiques, une méthode mixte a été utilisée impliquant un sondage téléphonique quantitatif (n=606) aux bureaux de santé de la région de Peel et d'Ottawa ainsi que des entrevues qualitatives en personne (n=15) à Ottawa. Les perceptions des risques étaient influencées par le revenu et le contrôle perçu, et les inquiétudes variaient des toxines dans les produits ménagers à la pollution de l'air. Une perception fréquemment soulevée était que les mères devraient automatiquement devenir plus inquiètes et prendre des mesures de protection dès qu'elles ont des enfants. Lorsque des obstacles financiers ou autres empêchaient aux mères de prendre des mesures de protection, telles que le changement de produits ou d'habitudes alimentaires, elles comptaient sur l'adaptation émotionnelle pour réduire leurs inquiétudes, telle que le choix d'ignorer l'information liée aux risques. Les sources d'information sur les risques environnementaux ont été examinées pour comprendre comment l'information est assimilée. Bien que la source la plus commune était l'Internet, plusieurs mères ne croyaient pas à la crédibilité du contenu et auraient préféré recevoir l'information de leurs professionnels de la santé. Cette recherche contribue à la compréhension des perceptions des risques et des

mesures de protection chez une population peu étudiée. Les résultats ont des implications pratiques pour la communication et gestion des risques ciblant les femmes enceintes et les nouvelles mères.

ACKNOWLEDGEMENTS

First, I would like to thank my supervisor Eric for giving me this opportunity and for never doubting me, even when I doubted myself. Thank you for all of the hours spent talking about the thesis and about life, and for all the moral support you've given me over the last two years. And of course, thank you for your unfailing willingness to provide guidance, insight, and feedback.

I would also like to thank my wonderful committee members for their involvement. Brian, thank you for teaching one of the most interesting classes of my academic career and for all of the support and positive feedback that you have given me. I always appreciate our chats, whether they are related to school or not. Louise, thank you for all of your feedback and expertise as a committee member as well as a co-author. Thank you also to the other co-authors of the first article for your feedback and excellent contributions: Jamie, Jeff, and Franca. A special thank you to Jeff for helping to make my first conference experience a great one.

Thank you to all the participants for taking part in the project. To those I interviewed, who in many cases welcomed me into their homes, for being open to sharing their experiences with me. A huge thank you is due to the Peel Region and Ottawa Public Health Units for taking an interest in our project and helping with recruitment.

This thesis would not have been possible without the staff in the Department of Geography; you have been friendly, welcoming, and helpful. A special thanks goes to Sonia for all the talks and advice, especially at field camp, and for enduring my excitement about your pregnancy. Thank you to the friends I have made in the Health and Environment Analysis Laboratory (HEALab) and in the other labs for all of the opportunities to talk, vent,

brainstorm, and laugh, for the somewhat inconsistent ‘weekly’ kitchen lunches but consistent moral support.

Last but certainly not least, thank you to my amazing parents for always providing me with love and support; I owe my successes in large part to you. To my friends, thanks for keeping me sane and filling my spare time with food and laughter. And to Ryan, thank you for your endless love, support, and encouragement, for always believing in me, and for reading drafts even though they made you sleepy. I wouldn’t be who or where I am today without you.

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PREFACE

This thesis follows the article format and consists of two research papers that are in preparation for submission to peer-reviewed journals. The background and objectives are described in Chapter 1: Introduction and the research papers are found in the following two chapters. The research papers that form the basis of this thesis are:

Chapter 2:

Laferriere, K. A., Crighton, E. J., Baxter, J., Lemyre, L., Masuda, J. R., & Ursitti, F. Examining inequities in children's environmental health: Results of a survey on the risk perceptions and protective actions of new mothers. (In preparation for submission to the Journal of Risk Research).

Chapter 3:

Laferriere, K. A., & Crighton, E. J. Environmental health risk perceptions, protective actions, barriers, and information sources: A qualitative study of mothers in Ottawa, Canada. (In preparation for submission to the journal BMC Public Health).

As the first author and Master's candidate I took primary responsibility for the research throughout the process; I analyzed the quantitative data, developed the interview guide, conducted and transcribed the interviews, interpreted the qualitative data, and wrote the manuscripts. Dr. Eric Crighton, Dr. Jamie Baxter, Dr. Louise Lemyre, Dr. Jeff Masuda, and Franca Ursitti conceptualized the initial project, developed the survey questionnaire, and provided input and editorial advice for the first paper, and Dr. Crighton provided input and editorial advice for the second paper and the thesis as a whole. This research was supported by the Social Sciences and Humanities Research Council (SSHRC) Standard Research Grant [410-2009-0951, Crighton P.I.], and the Ontario Graduate Scholarship (OGS) program.

CHAPTER 1

Introduction

1.1 Background

There is an ever-growing list of environmental health risks reported in the media, ranging from pesticides and additives in foods, to chemicals in household products, to contaminants in indoor and outdoor air. Despite the continued technological advances leading to improved healthcare, higher life expectancy, and reduced infant mortality, the rates of many chronic diseases are increasing and environmental exposures are reported to be a significant contributing factor (Nieuwenhuijsen, Dadvand, Grellier, Martinez, & Vrijheid, 2013; Schlotz & Phillips, 2009; Stillerman, Mattison, Giudice, & Woodruff, 2008; Tyshenko et al., 2007). The World Health Organization (2009) estimates that the environmental burden of disease accounts for 13% of the total disease burden. Given mothers' traditional roles as primary caregivers and the vulnerability of young children to environmental health risks, risk messages targeting new mothers can be expected to evoke concern and subsequent protective action. However, some individuals may face barriers that prevent them from taking precautionary measures, such as financial or language barriers, while facing the additional burden of being more exposed to contaminants due, for example, to adverse neighbourhood characteristics and housing conditions. Although much research has been done regarding risk and risk perception in the general population in Canada (Krewski et al., 2006; Lee, Lemyre, Mercier, Bouchard, & Krewski, 2005; Lemyre, Lee, Mercier, Bouchard, Krewski, 2006) and elsewhere (Lidskog, 1996; Marshall, 2004; Vaughan & Dunton, 2007; Wood & Della-Monica, 2011), little research has specifically examined mothers' risk perceptions and protective actions. The goal of this research is to improve our understanding of the ways in

which mothers perceive and respond to environmental health risks to their young children across socioeconomic and geographic contexts. This is accomplished through a mixed-method approach, including a quantitative survey (Chapter 2) and qualitative interviews (Chapter 3).

Children's environmental health has received much attention in the recent literature, and studies have found that prenatal and early childhood exposures to environmental contaminants can affect pregnancy outcomes, child health, and long-term health (Canadian Partnership for Children's Health & Environment [CPCHE], 2005; Dunkel Schetter, 2011; Le Cann et al., 2011; Schlotz & Phillips, 2009; Stillerman et al., 2008; Tyshenko et al., 2007). More specifically, exposures to environmental health hazards have been associated with low birth weight, birth defects, pregnancy loss, learning disabilities, behavioural disorders, psychiatric conditions, respiratory conditions, cancer, and adult-onset chronic diseases (CPCHE, 2005; Schlotz & Phillips, 2009; Stillerman et al., 2008; Tyshenko et al., 2007). Children are more exposed and vulnerable to environmental health hazards than adults. This is because they consume more food, water, and air than adults relative to body weight; breathe more quickly at a lower height than adults, where more dust and contaminants are found; and ingest more contaminants by engaging in hand-to-mouth exploration and by consuming more of the same food sources from a much less varied diet (CPCHE, 2005; Le Cann et al., 2011; Tyshenko et al., 2007). They are also exposed to contaminants prenatally through the placenta (Schlotz & Phillips, 2009; Stillerman et al., 2008; Tyshenko et al., 2007). Furthermore, the immaturity of their respiratory, digestive, and immune systems increases their vulnerability to environmental exposures (CPCHE, 2005; Le Cann et al., 2011; Tyshenko et al., 2007).

Although all children are vulnerable to environmental health hazards, some face greater exposures than others. Substantial research has shown that socioeconomic status (SES), as determined by income, education, and occupation, is significantly linked with health outcomes: "individuals lower in SES experience higher rates of morbidity and mortality in almost every disease category than individuals higher in SES, regardless of whether SES is measured by education, income, or occupation" (Chen, Matthews & Boyce, 2002, p. 295; Ho, Davidson & Ghea, 2005; Matthews & Gallo, 2011). Children born into families with low SES are no different; they tend to face higher mortality rates due to chronic conditions and greater exposures to environmental hazards (Chen et al., 2002; Frohlich, Ross, & Richmond, 2006; Ho et al., 2005; Le Cann et al., 2011; Matthews & Gallo, 2011; Prus, 2011). Correspondingly, lower SES has been found in some contexts to be associated with greater proximity to hazardous sites, industries, and major roadways, higher levels of indoor air pollution, as well as higher levels of stress and behavioural risk factors including smoking, poor nutrition, less frequent doctor visits and a greater tendency to put off seeking medical attention (Chen et al., 2002; CPCHE, 2005; Marshall, 2004; Matthews & Gallo, 2011). All of these factors can affect children from low SES families, putting them at greater risk for health conditions associated with environmental exposures.

Understanding the ways people access, perceive, and respond to risk information is important for the development of effective risk communication strategies. However, according to Hawkes & Rowe (2008): "there is no widely accepted model of risk perception that indicates what factors are related to risk perception, and in what way, and there is no theory that might help researchers and policy makers predict public responses to novel potential hazards" (p. 618). Yet many relevant theories have been developed to inform our

understanding of risk perceptions and responses. One of the first theories on perceived risk is the *psychometric paradigm*, in which participants' perceptions of different hazards are based on factors such as dread, familiarity, control, and catastrophic potential (Keller et al., 2012). While this paradigm has contributed to our understanding of how and why some hazards are perceived differently than others (e.g. how nuclear accidents are perceived compared to genetically modified foods), it ignored the variation in how individuals perceive risks differently (e.g. how risks are perceived by women compared to men). More recently, the focus of some risk perception research has shifted to examine the positive or negative feelings associated with risks, or *affect*. Several researchers have studied risk perception using an emotion-specific approach, some of which have used *appraisal theory*. This theory examines risk perceptions and actions as determined by both affective and cognitive appraisals of risks (Keller et al., 2012). Approaches that focus on individual differences in risk perception are useful for understanding "the more complex relationships between beliefs, attitudes, and behaviors, with practical benefits, for example, in risk communication to different groups of individuals" (Keller et al., 2012, p.240). Individual differences need to be taken into account when examining mothers' risk perceptions and protective actions as they relate to their children's environmental health, to ensure that the findings can inform the development of effective and more targeted risk communication strategies and public health programs.

Several common empirical findings in the risk perception literature have highlighted the variety of factors affecting risk perception, ranging from media coverage to income. For example, according to the *availability heuristic*, people perceive risks to be more likely when they can easily imagine or recall a similar event, or if one has recently been widely

publicized in the media (Keller et al., 2012). However, news stories often focus on acute events rather than chronic ones, which can explain why improbable yet highly damaging events, such as a nuclear accident, may be perceived as riskier than high probability daily risks that are less likely to receive widespread or consistent news coverage, such as toxic chemicals in household products. Trust has also been found to influence risk perception, where high levels of trust in and acceptance of expert assessments tends to lead to reduced perceptions of some health risks (Bickerstaff, 2004; Goldstein, 2005; Hawkes & Rowe, 2008; Keller et al., 2012; Lee et al., 2005; Lidskog, 1996). Within the Canadian literature, it has been shown that perceptions of various health risks, ranging from chemicals and contaminants to medical x-rays, vary by gender, age, education, and income, with female, older, less educated, and lower income respondents generally perceiving risks to be higher (Krewski et al., 2006; Lee et al., 2005; Lemyre et al., 2006). Several researchers explain their findings in relation to control, whereby individuals who report a lower sense of control in society – for example, women, ethnic minorities, and low SES individuals – perceive risks to be higher (Bickerstaff, 2004; Brody, Zahran, Vedlitz, & Grover, 2008; Krewski et al., 2005; Lemyre et al., 2006; Marshall, 2004).

Risk perception has been found to influence protective action. The amount of concern associated with a risk can affect the likelihood of taking action in that too little concern may not provide adequate motivation to act, while overwhelming concern may hinder the ability to take action (Thirlaway & Heggs, 2005; Wood & Della-Monica, 2011). The ability of an individual to take protective action is also mediated by the resources they have available to effect change (Harvatt, Petts, & Chilvers, 2011). Low SES can make it difficult to take simple protective actions, such as consuming organic foods or purchasing 'higher quality'

children's products, when there are financial or other barriers (Ho et al., 2005; Mackendrick, 2011; Thoolen, De Riddler, Bensing, Gorter, & Rutten, 2008). Further, low SES has been found to reduce the inclination to carefully analyze and process risk messages, leading to maladaptive coping, which is the failure to manage a threat effectively (Vaughan & Dunton, 2007).

Many theories have been developed to attempt to explain the coping mechanisms people use when they face risks. Lazarus and Folkman (1984) propose the *psychosocial model of stress* to explain diverse coping strategies. They suggest that if an individual cannot use *problem focused coping* (directly taking action to reduce a risk such as moving to avoid a hazard associated with adverse housing conditions or changing purchasing habits), due to financial or other barriers, they may rely on *emotion focused coping* (using psychological defence mechanisms to deal with feelings of distress and vulnerability). One form of emotion focused coping is o*ptimistic bias*, where denial is used to defend oneself against stress when a threat cannot be removed through direct action. The result of this denial is that one perceives the level of personal risk as lower than that of others even if the actual risk is the same (Hawkes & Rowe, 2008; Keller et al., 2012). Thoolen et al. (2008) refer to this as *reality based defensive denial*. Another related theory identified in the literature is an emotion focused approach to coping with *cognitive dissonance*; when people hold two conflicting cognitions – for example, a desire to consume organic food and knowledge of the inability to afford it – they may try to reduce dissonance by, for example, being unrealistically optimistic about their ability to avoid poor outcomes (Festinger, 1956; McMaster & Lee, 1991). *Protection motivation theory* discusses the processes of action and inaction as they relate to threat-appraisal (the benefits of action and inaction are compared,

with consideration of the risk's severity and one's vulnerability) and coping-appraisal (assessing the likelihood that taking action will reduce the risk and the individual's ability to effectively take action given the necessary financial and other resources) (Floyd, Prentice-Dunn, & Rogers, 2000). It is unclear how these theories may inform our understanding of risk perceptions and behavioural responses to everyday environmental exposures or their relevance among new mothers, a population where little risk perception research has previously focused.

To protect their children from environmental health risks, women are commonly expected to fulfill established gender roles, including being primary caregivers and bearing much of the responsibility for decision-making with regard to children and family health (Mackendrick, 2011). Women are often responsible for the majority of unpaid domestic duties, including shopping, cooking, and cleaning, which have implications for potential hazard exposures (Ho et al., 2005; Mackendrick, 2011; Thirlaway & Heggs, 2005). There is societal pressure on mothers to be risk conscious at all times and to "discipline virtually all dimensions of their bodies and behaviours […] in accordance with elaborate, ever-proliferating, ever-changing rules of risk minimization" (Kukla, 2010, p. 324). Given their often tacit roles as primary caregivers and the vulnerability of young children to environmental health risks, mothers are an important, yet understudied, group to focus on in risk perception research.

1.2 Conceptual framework

Based on the review of the theoretical and empirical literature undertaken for this project, a conceptual framework was developed to inform this research, using a holistic approach to

understand the multilevel factors that influence risk perception, protective action, barriers, and coping (see Figure 1.1). This framework illustrates the potential bidirectional relationships that exist between risk perception and protective action, the barriers and facilitators that may affect both risk perception and protective action, and the overarching influence of individual characteristics as well as socioeconomic and geographic contexts. While much research examines risk perceptions and associated behaviours in the general population, this research focuses on a specific population in which the variability of broader contextual factors and the existence of barriers must be taken into account.

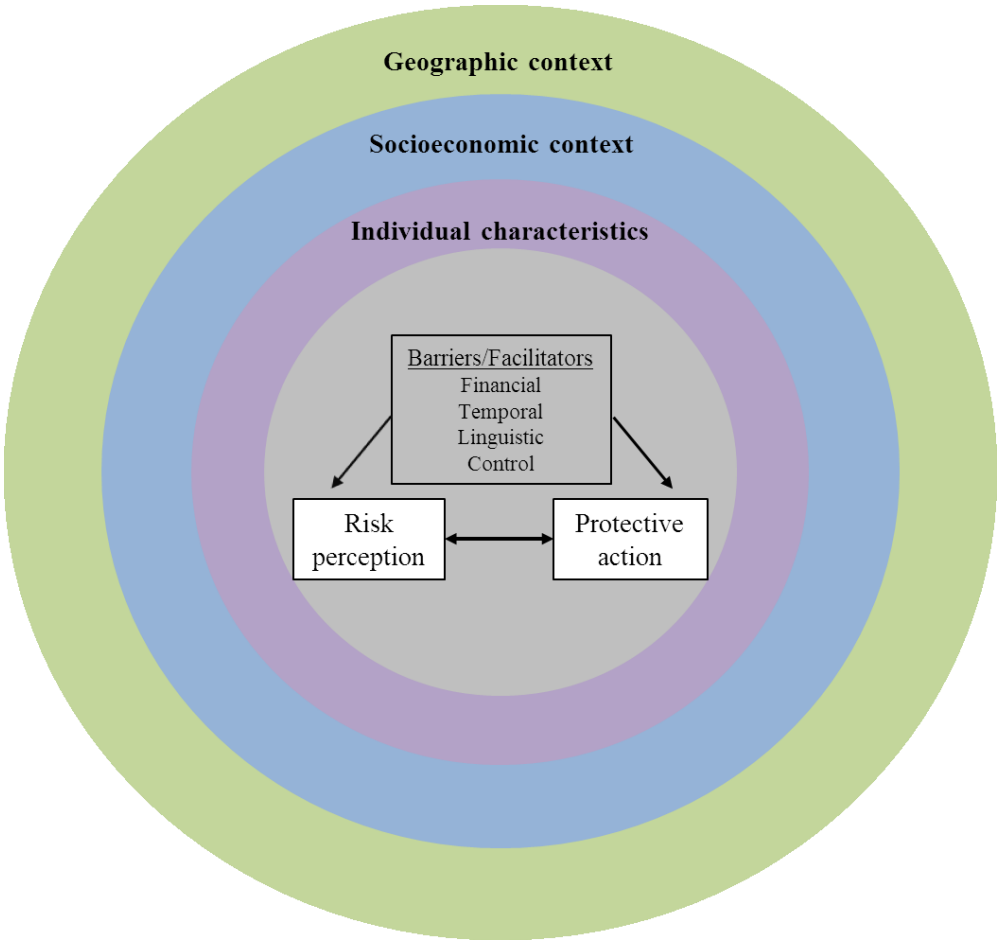

Figure 1.1 Conceptual framework

This framework illustrates that the level of risk perception, or of concern, can influence the decision to take (or to not take) action to protect oneself and one's family (Rose, 2010; Thirlaway & Heggs, 2005). Subsequently, effectively taking action can be expected to reduce levels of concern about perceived risks, while the inability to take action can lead to emotion focused coping, such as optimistic bias, to reduce the concern and stress associated with the risk (Festinger, 1957; Lazarus & Folkman, 1984; McMaster & Lee, 1991). The ability or inability to take protective action may be the result of barriers and facilitators that are financial, temporal, or linguistic, and that prevent or enable access to the resources necessary to identify and carry out protective actions (Harvatt et al., 2011; Ho et al., 2005; Mackendrick, 2012; Thoolen et al., 2008). The same barriers and facilitators may influence the ability to access the resources needed to acquire and understand environmental health risk information in the first place (Vaughan & Dunton, 2007). Furthermore, control can act as a barrier or facilitator that can influence both risk perceptions and protective actions, in that those with a lower sense of control often perceive risks to be greater (Krewski et al., 2006), while risks that are beyond individual control (e.g. exposure to outdoor air pollution) make taking protective action difficult. All of these relationships can be influenced by individual characteristics such as age, gender, ethnicity, and language, as well as socioeconomic factors such as income and education, and geographic contexts (Brody et al., 2008; Krewski et al., 2006; Lee et al., 2005; Lemyre et al., 2006; Marshall, 2004).

1.3 Objectives

Very few risk perception studies have targeted new mothers, despite the vulnerability of young children to environmental health risks and the traditional roles of mothers as

managers of family health. This study seeks to begin addressing the gap in the literature and to further the understanding of risk perception and protective action in this population. As part of a larger research project, this thesis uses a mixed-method design, involving a quantitative telephone survey and qualitative face-to-face interviews, to examine the concerns and protective actions of new mothers in two Public Health Units in Ontario, Canada. The primary objectives of this study are to:

1. Investigate new mothers' perceptions about environmental health risks to their children;
2. Examine their protective actions in response to perceived risks;
3. Determine the potential role of individual, socioeconomic, and geographic factors in affecting perceptions and protective actions; and,
4. Identify the main sources of environmental health risk information for new mothers, as well as preferences regarding sources and timing of access.

1.4 Organization of thesis

This thesis is organized into four chapters, including this first introduction chapter. The second and third chapters consist of the articles that address the research objectives presented above. Chapter 2 quantitatively examines the perceptions and protective actions of new mothers using a telephone survey. This phase examines new mothers' awareness and concerns about environmental health risks, their protective actions and barriers to taking action, and how these factors vary across individual, socioeconomic, and geographic contexts. Chapter 3 uses face-to-face interviews to qualitatively examine the first three objectives explored in the Chapter 2 in more depth, as well as the fourth objective, with a

subsample of the survey participants. In addition to examining mothers' concerns and protective actions, this phase examines issues related to information access and preferences. The mothers were interviewed up to two years after their initial participation in the study, allowing for insight into the ways perceptions and protective actions change as children age. Chapter 4 concludes the thesis, summarizing the major findings of the study. It also discusses its theoretical, methodological, and practical contributions, outlines its limitations, and proposes directions for future research.

CHAPTER 2

Examining inequities in children's environmental health: Results of a survey on the risk perceptions and protective actions of new mothers

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Manuscript in preparation for submission to the Journal of Risk Research

Abstract

Young children are more highly exposed and vulnerable to environmental health hazards than adults due to a variety of physiological and behavioural factors. Despite the significant responsibility mothers typically bear in managing their children's health, little is known about how they perceive and negotiate these risks in their day-to-day lives. To better understand mothers' environmental health risk perceptions and associated protective actions across socioeconomic and geographic contexts, a telephone survey was conducted among new mothers (n=606) recruited through two Public Health Units in Ontario, Canada. Analyses revealed that approximately half of the respondents were moderately or highly concerned about environmental health risks, ranging in nature from household products to outdoor air contaminants. Factors affecting the likelihood of experiencing concern included income and perceived control. With regard to protective actions, forty-three percent reported taking three or more actions to reduce environmental health risks to their children, with the likelihood of taking action being negatively affected by factors including low income and first language other than English or French, and positively affected by being a first time parent (primiparous). This study contributes to our understanding of environmental health risk perceptions and associated protective behaviours among new mothers, and has implications for the development of more context-focused risk management and communication strategies.

Keywords: risk perception; protective action, new mothers; environmental health; inequity

2.1 Introduction

According to Ulrich Beck's risk society theory (1992), we are facing more and different risks than ever before due to industrial and scientific advancements, risks that can no longer be sufficiently contained in time (long-lasting consequences) or in space (impacts cross geographic boundaries). However, risks are not distributed evenly across society; some social groups may face higher exposures and, especially, be less able to avoid risks (Cooper, 2008). Although infant mortality has been significantly reduced in Canada, the rates of numerous chronic diseases in children are increasing and environmental exposures are reported to be a significant contributing factor (Nieuwenhuijsen et al., 2013; Schlotz & Phillips, 2009; Stillerman et al., 2008; Tyshenko et al., 2007). Children face higher rates of exposure and are more vulnerable to acute and chronic health conditions than adults due to a wide range of physiological and behavioural factors (CPCHE, 2005; Knaak, 2010; Kukla, 2010). Environmental health risks could be expected to be particularly concerning for mothers and pregnant women, given their traditional roles as primary caregivers and the vulnerability of infants to such risks. As a result, mothers may want to take precautionary measures in an effort to limit exposures to their children by, for instance, avoiding purchasing products containing harsh chemicals or by consuming organic food (Mackendrick, 2012). However, some populations (e.g. lower income, new immigrants) may lack the information or resources necessary to take precautionary measures, facing a double burden of higher concern yet lower response efficacy. In addition, these populations may be more exposed to contaminants due, for example, to adverse neighbourhood characteristics and housing conditions (Chen et al., 2002; CPCHE, 2005; Marshall, 2004; Matthews & Gallo, 2011). While we have learned a great deal in recent years about risk perceptions in the

general population (Krewski et al., 2006; Lee et al., 2005; Lemyre et al., 2006), little is known about new mothers' risk perceptions and associated behaviours as they relate to their children's environmental health. Building on the findings of a previous qualitative study in which new mothers were interviewed and public health key informants participated in focus groups (Crighton et al., 2013), this paper presents the results of a quantitative survey conducted among new mothers in Ontario, Canada, examining perceptions and protective actions related to environmental health risks to children across socioeconomic and geographic contexts.

2.2 Context

Recent literature is replete with studies finding that prenatal and early childhood exposures to environmental contaminants can affect immediate and long-term health outcomes, and that children are more exposed and vulnerable to such risks than adults. In addition to being exposed vicariously to contaminants in-utero, relative to body weight children consume more food, water, and air than adults; they breathe more quickly at a lower height than adults, where more dust and contaminants are found; and they ingest more contaminants by engaging in hand-to-mouth exploration and by consuming more of the same food sources from a much less varied diet (CPCHE, 2005; Le Cann et al., 2011; Schlotz & Phillips, 2009; Tyshenko et al., 2007). Children are more vulnerable to environmental exposures due to the immaturity of their respiratory, digestive, and immune systems (CPCHE, 2005; Le Cann et al., 2011; Tyshenko et al., 2007). Although all children are vulnerable to environmental hazards, some face greater exposures than others. For example, numerous studies in the United States have found that lower socioeconomic status (SES) is

associated with greater proximity to hazardous sites, industries, and major roadways, higher levels of indoor air pollution, as well as higher levels of stress and behavioural risk factors including smoking, second hand smoke, and poor nutrition (Chen et al., 2002; Marshall, 2004; Matthews & Gallo, 2011). Low SES is also significantly linked with poorer health outcomes; children born into families with low SES tend to face higher mortality rates due to chronic conditions, acute conditions, and injuries, as well as greater exposures to environmental hazards (Chen et al., 2002; Frohlich et al., 2006; Ho et al., 2005; Le Cann et al., 2011; Matthews & Gallo, 2011; Prus, 2011; Wigle et al., 2008). These compounding social, behavioural, and physiological risk factors represent an important inequity, yet have received little attention within Canadian or international environmental or health policy (Masuda, Zupancic, Poland, & Cole, 2008).

Health risk perceptions among the general Canadian population have been found to vary by gender, age, education, and income, with female, older, less educated, and lower income respondents perceiving risks to be higher (Krewski et al., 2006; Lee et al., 2005; Lemyre et al., 2006). Marshall (2004) and Brody et al. (2008) found that white men tend to perceive risks to be lower than do women and ethnic minorities. This they refer to as the 'white male' effect, which may be explained by white males' greater sense of control in society. In a Canadian context, the importance of control was also identified by Krewski et al. (2006) as a key influence on risk perception; respondents with a strong sense of control, whether they take protective actions or not, perceive risks to be lower. Similarly, Lemyre et al. (2006) found that women and lower SES individuals perceive risks to be greater, a finding they suggest could be due in part to a lack of control and unequal power relations (see also Flynn, Slovic, & Mertz, 1994; Gustafson, 1998). In addition to a lack of control, low SES can

contribute to feelings of powerlessness, pessimism, and less inclination to carefully analyze and process risk messages, which can lead to maladaptive coping (failure to manage the threat effectively) (Vaughan & Dunton, 2007).

To protect their children from environmental health risks, women tend to be tacitly expected to fulfill established gender roles, such as bearing more responsibility than men for family health and decision-making (Ho et al., 2005; Thirlaway & Heggs, 2005). This can put tremendous pressure on pregnant women and mothers to limit risks to their children and to "discipline virtually all dimensions of their bodies and behaviours (what they eat and drink, where they work and recreate, when and how they exercise, and so forth) in accordance with elaborate, ever-proliferating, ever-changing rules of risk minimization" (Kukla, 2010, p. 324). Society's expectations of the maternal role as that of a 'risk manager,' obliged to be risk conscious and responsible at all times, makes it even more difficult for mothers to navigate increasingly complex and confusing risk information (Knaak, 2010; Kukla, 2010).

The ability to take protective action in response to risks is mediated by one's resources to effect change (Harvatt et al., 2011). Barriers, often associated with low SES, can range from financial to temporal and can significantly reduce the ability to respond to health risks including, for example, using a precautionary approach when purchasing and consuming organic food and non-toxic household products (Ho et al., 2005; Mackendrick, 2012; Thoolen et al., 2008). Therefore, even though health problems associated with environmental exposures may be largely preventable in principle, people who face seemingly insurmountable barriers may be unable to take the actions necessary to reduce risks (CPCHE, 2005; Mackendrick, 2012; Thoolen et al., 2008). The amount of worry associated with risks can also influence protective behaviours; while some worry may encourage

protective action, too little or too much worry can have the opposite effect (Thirlaway & Heggs, 2005; Wood & Della-Monica, 2011). Several theories attempt to understand the coping mechanisms people use when facing risks. The concept of cognitive dissonance suggests that people experience potentially health-harming discomfort when they simultaneously hold two 'cognitions' (for example, preference for pesticide-free foods, but an awareness of the inability to afford such food), and that they may try to reduce dissonance in several ways (for example, unrealistic optimism about their ability to avoid a risk) (Festinger, 1957; Mcmaster & Lee, 1991). Similarly, Lazarus and Folkman (1984) suggest that if an individual facing a stressor cannot remove the threat through direct action, he/she may use denial as a mechanism to defend him/herself against stress. The protection motivation theory (Floyd et al., 2000), which involves threat-appraisal and coping-appraisal, addresses coping mechanisms leading to action or inaction. During the threat-appraisal process, the benefits of action and inaction are compared with consideration of the risk's severity and one's vulnerability, while coping-appraisal takes into account whether or not taking action will reduce the risk and the individual's ability to effectively take action, given the potential financial and temporal costs.

Very few studies have targeted new mothers' perceptions of environmental health risks. One exception is a study by Evans, Fullilove, Green, and Levison (2002) examining visible minority women's awareness of environmental health risks and protective actions in New York City. Using a questionnaire asking about specific environmental risks, including lead and pesticides, and precautions taken to reduce these risks, findings include high levels of awareness for most identified hazards (i.e. >95%), and similarly high levels of precautionary actions. While this study provides some important insights into environmental risk

perceptions and actions in this population, it is limited by the leading nature of the questions asked. Further, while participants were all of child bearing age, they were not necessarily all mothers.

In an effort to better understand environmental health risk perceptions and protective actions of new mothers across socioeconomic and geographic contexts, a three-phase study was developed to examine this topic. In the first phase, qualitative interviews and focus groups were conducted with new mothers and public health key informants, respectively (Crighton et al., 2013). Participants' levels of concern ranged from having no concerns to actively incorporating prevention in their day-to-day life (for example, switching to safer household products). Risks that mothers perceived as controllable, such as those within the home, were found to evoke less concern, in contrast to less controllable risks outside the home. Participants reported using a diverse range of coping strategies to deal with concerns, including relying on children's bodies to adapt. In addition, a degree of optimistic bias was identified among participants, with mothers reporting that other children in similar circumstances were at greater risk than their own.

Building on these findings, the current study (Phase 2) examines ideas of risk perception and protective action across a larger and more diverse sample, using a quantitative approach. Children's vulnerability to environmental health risks and the disproportionate responsibilities women tend to have in managing family health make understanding the ways mothers in varying contexts perceive and respond to health risk information particularly important. Thus, the main objectives of this study were to: (1) investigate new mothers' perceptions about environmental health risks to their children; (2) examine their protective

actions in response to perceived risks; and, (3) determine the potential role of individual, social, economic, and geographic factors in affecting risk perceptions and protective actions.

2.3 Methodology

This study employed a telephone survey of 606 new mothers living in two out of thirty six Public Health Units (PHUs) in Ontario, Canada: Peel Region and Ottawa (Figure 2.1). This study was the second phase of a larger mixed-method research project. The first phase involved interviews with new mothers and focus groups with public health key informants (Crighton et al., 2013), and the third phase involves interviews with a subsample of the survey respondents approximately two years after initial participation (Chapter 3). This research was approved by the University of Ottawa Research Ethics Board, the Ottawa Public Health Ethics Board, and meets all the ethics criteria of Peel Public Health.

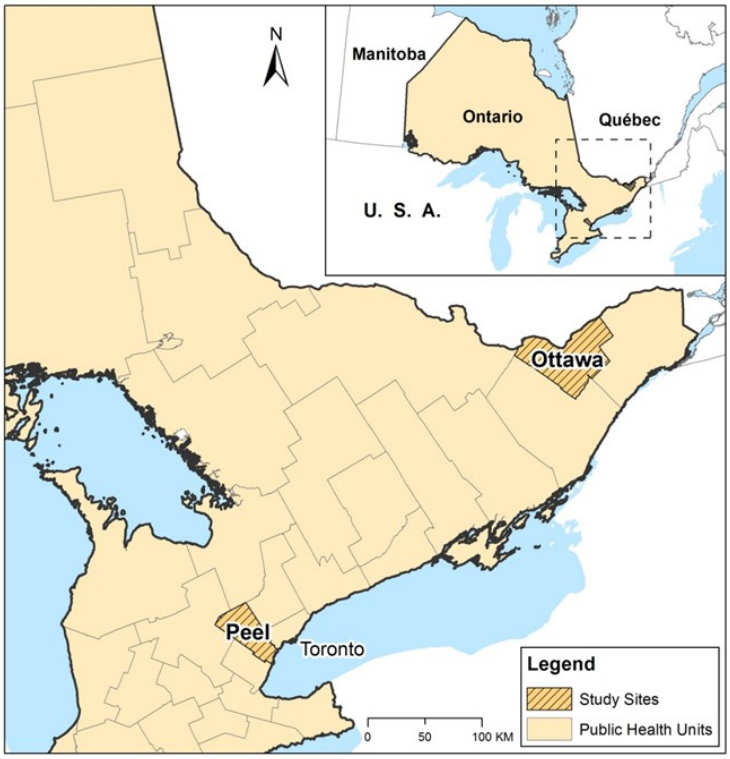

Figure 2.1 Study sites, Peel Region and Ottawa PHUs, Ontario, Canada

2.3.1 Study sites

Resources allowed for two study sites and the specific PHUs were selected for their ethnic, socioeconomic, and urban/rural diversity and each expressed interest in both environmental health issues and in participating in the study. Both sites are large urban centered PHUs with significant rural catchments. However, Ottawa, Canada's national capital, faces relatively few overt outdoor environmental problems due in part to its location away from the industrial heart of Ontario, as well as fewer and smaller busy highways and airports than are found in the Toronto area. Ottawa is relatively affluent (median family income: $96,307 in Ottawa vs. $85,524 in Peel) and has a highly educated population (62% over the age of 15 with post-secondary education in Ottawa vs. 56% in Peel) (Statistics Canada, 2011). Ottawa also has a significant French speaking community and, in comparison to Peel, a smaller immigrant population (19% in Ottawa versus 51% in Peel) (Statistics Canada, 2011). Conversely, Peel Region, which neighbours the City of Toronto and is part of the Greater Toronto Area (GTA), faces more outdoor air quality and other environmental problems (Ontario Ministry of the Environment, 2013). Despite similar population sizes (Statistics Canada, 2011), Peel has over 300 facilities reporting to the National Pollutant Release Inventory in 2009 compared to only 107 in Ottawa (Environment Canada, 2009), it has Canada's largest airport, and it has several of Canada's busiest highways running through it. Further, trans-boundary air pollution from heavy industries in the Midwest of the United States significantly impacts air quality in the Windsor to Quebec City corridor, with Peel being impacted to greater extent than Ottawa (Ontario Ministry of the Environment, 2005).

2.3.2 Data and sample

Working directly with Peel Region and Ottawa PHUs, participants were recruited through the *Healthy Babies Healthy Children* (HBHC) program. This program provides, among other services and resources, a postpartum phone call to all new mothers by public health nurses to ensure risks to healthy development are identified. During the phone calls, nurses recruited participants by reading a statement about the study and asking whether they would be willing to participate in a telephone survey. The questionnaire was subsequently administered by EKOS Research Associates in English or French and was designed to require no more than 30 minutes to complete, taking into account the time constraints of new mothers. Callbacks were made to respondents who were unable to complete the questionnaire due to interruptions (for example, from their young babies). The recruitment of participants and administration of the questionnaire took place between June 2011 and April 2012. Of the 1111 new mothers who were invited to participate by the PHUs and agreed to be contacted (Peel: n=565; Ottawa: n=546), 606 completed the questionnaire (Peel: n=280; Ottawa: n=326). This represents a response rate of 55%.

Sample characteristics are presented in Table 2.1, broken down by study site. Both income and education levels were higher in Ottawa than in Peel, with 41% of the Ottawa sample earning a household income above $120,000 per year compared to only 22% in Peel, and with 72% of the Ottawa sample having an undergraduate or graduate university degree compared to 55% in Peel. In Peel, the proportions of immigrants, visible minorities, and women with a first language other than English or French were larger. In both Peel Region and Ottawa the mean age was 31, and ranged from 18 to 45 years.

Table 2.1 Sample characteristics

Characteristic	Peel (n=280)		Ottawa (n=326)		Total	
	%	(n)	%	(n)	%	(n)
Household income						
≥$120,000	21.5	(51)	40.8	(125)	32.4	(176)
$80-119,999	36.7	(87)	32.7	(100)	34.4	(187)
$40-79,999	20.3	(48)	19.0	(58)	19.5	(106)
<$40,000	21.5	(51)	7.5	(23)	13.6	(74)
Education						
Graduate degree	24.2	(67)	32.6	(107)	28.8	(174)
Bachelor's degree	31.0	(86)	39.6	(130)	35.7	(216)
College	27.4	(76)	17.7	(58)	22.1	(134)
High school or less	17.3	(48)	10.1	(33)	13.4	(81)
Married/common law	90.6	(252)	95.1	(312)	93.1	(564)
Immigrant	57.6	(160)	23.2	(76)	38.9	(236)
Visible minority	35.7	(95)	19.5	(64)	26.8	(159)
First language English or French	49.6	(137)	80.5	(264)	66.4	(401)
First child	54.0	(150)	56.7	(186)	55.4	(336)
Mean age (years)	*31*		*31*			

2.3.3 Variables and measures

The development of the questionnaire was informed by the first phase of the study (see Crighton et al., 2013). The questionnaire was comprised of five major sections: (1) introduction and family health; (2) awareness and concern about environmental health risks in general and in the home, neighbourhood, and workplace; (3) protective actions taken and barriers to taking action; (4) sources of information; and (5) socioeconomic and demographic characteristics (see Appendix 1). The two outcome variables of interest for this analysis are *general concern* and *protective action*. General concern is defined here as the reported overall level of concern that environmental health hazards may be harming their children's health, measured on a four-point Likert scale, ranging from not concerned to very concerned. Protective action is defined as the number of action items mothers reported taking in order to protect their child's health (for example, switching to safer cleaning products or staying indoors during high smog days). The numbers of protective actions taken were summed and four 'action level' categories were created: none (0), low (1-2), moderate (3-4) and high (5+). Due to small counts in some categories, outcome variables were made

dichotomous (no/low concern and moderate/high concern; no/low level of protective action and moderate/high level of protective action). The explanatory variables used in this analysis include location, household income, education level, visible minority status, immigrant status, first language, age, and first child. Indices were created to measure levels of perceived control and reported awareness, each based on three survey questions on related themes.

2.3.4 Analysis

The analysis of the survey data involved bivariate and multivariate statistical techniques in order to understand the perceptions and protective actions of new mothers regarding environmental health risks. The analysis was completed using IBM SPSS Statistics (version 20, SPSS Inc., Chicago). Bivariate analysis was used to identify significant relationships of explanatory variables with outcomes of interest, for inclusion in regression models. Several non-significant variables (age, education, location, protective action, and general concern) that were deemed of *a priori* importance (Brody et al., 2008; Krewski et al., 2006; Lee et al., 2005; Lemyre et al., 2006; Marshall, 2004) were forced into the models. Binary logistic regression was used to examine the multivariate relationships between the explanatory and outcome variables, and was chosen based on the categorical nature of the explanatory variables and the dichotomous nature of the outcome variables (Burns & Burns, 2000).

2.4 Results

To understand what kinds of risks mothers were aware of, open-ended questions were used to determine what environmental health hazards, if any, respondents had heard or read about (Table 2.2). The most commonly mentioned hazards were household products (19%), including chemicals in cleaning products, and plastics and canned goods. Nine percent

mentioned outdoor risks, including air and water pollution. Food risks, including mercury in seafood and other foods to avoid during pregnancy, and indoor environment risks, including exposure to cigarette smoke and dust, were each mentioned by eight percent of respondents. Forty-six percent did not mention any environmental health hazards. Information about these hazards most commonly came from the Internet (58%), followed by television (21%). Only eight percent reported that they had received any information about environmental health hazards from healthcare professionals or public health, despite almost a third of the total sample (27%) reporting this to be their preferred source. When asked if they were taking actions to protect their young children against reported hazards, 82% said they were (at least one). The most common protective actions mentioned were: stop using unsafe household products (or start using safer ones); and, change eating habits by, for example, avoiding preservatives, opting for organic foods, or improving overall diet. Of the 56 participants who reported that they wanted to take protective action but were unable to, 43% reported that this was because of financial constraints, and 27% felt that there were no protective actions they could take. In other words, the risks were beyond their control.

Table 2.2 First mentions of environmental health hazards heard or read about

Hazards	n	%
Hazardous products	**112**	**19.8**
Cleaning and household products	58	10.2
Plastics and canned goods	26	4.6
Other products[1]	28	4.9
Outdoor environment	**51**	**9.0**
Air quality[2]	17	3.0
Water quality[2]	15	2.7
Other outdoor hazards[3]	19	3.4
Indoor air quality[4]	**45**	**7.9**
Food[5]	**45**	**7.9**
Radiation technology	**10**	**1.8**
Extreme heat/sun exposure	**6**	**1.1**
Non-environmental hazards[6]	**36**	**6.4**
None	**262**	**46.2**

[1]E.g. Chemicals in beauty products, paint, lead, flame retardants
[2]E.g. Pollution/contaminants
[3]E.g. Fertilizers/pesticides in green spaces, dumps, landfills
[4]E.g. Cigarette smoke (2nd, 3rd hand), dust, carbon monoxide, asbestos
[5]E.g. Mercury in seafood, toxins/additives in foods, foods to avoid when pregnant
[6]Hazards not commonly considered environmental such as alcohol, caffeine, medication, crib safety, vaccines, stress, illness

Table 2.3 shows the bivariate results of the cross-tabulations between explanatory variables and the main outcomes of interest: general concern and protective action. With regard to general concern, almost half (49%) of the respondents reported high or moderate levels of concern that environmental hazards may harm their baby's health. Women who lived in Peel and those who lived in lower income households, were immigrants, and had lower levels of perceived control reported significantly higher levels of concern. Education level, visible minority status, first language, age, first child, reported awareness, and protective actions were not significantly associated with reported levels of concern in the cross-tabulations.

In regard to protective action, 43% of the respondents reported taking multiple (three or more) actions to protect their baby, defined here as being a high or moderate level of action. High or moderate levels of protective action were found to be positive and significantly associated with the following variables: household income, education, Canadian-born, non-visible minority, English or French as a first language, first-time parent (primiparous), and

level of awareness. Location, age, perceived control, and general concern were not found to be significantly associated with protective action.

Table 2.3 Bivariate cross-tabulations for mothers' levels of general environmental health concern and protective action

Characteristics	General concern		Protective action	
	High/Moderate % (n)	Low/None % (n)	High/Moderate % (n)	Low/None % (n)
Total	49.4 (295)	50.6 (302)	43.2 (261)	56.8 (343)
Location	p < .001		ns	
Ottawa	40.7 (132)	59.3 (192)	46.2 (151)	53.8 (176)
Peel	59.7 (163)	40.3 (110)	39.7 (110)	60.3 (167)
Household income	p < .01		p < .001	
$120,000 +	40.6 (71)	59.4 (104)	59.1 (104)	40.9 (72)
$80,000-119,999	51.3 (96)	48.7 (91)	42.8 (80)	57.2 (107)
$40,000-79,999	48.5 (50)	51.5 (53)	40.0 (42)	60.0 (63)
< $40,000	63.5 (47)	36.5 (27)	20.3 (15)	79.7 (59)
Education	ns		p < .01	
Graduate degree	52.0 (89)	48.0 (82)	49.4 (86)	50.6 (88)
Bachelor's degree	45.1 (97)	54.9 (118)	48.1 (104)	51.9 (112)
College/CEGEP	54.2 (71)	45.8 (60)	33.1 (44)	66.9 (89)
High school or less	47.5 (38)	52.5 (42)	33.3 (27)	66.7 (54)
Immigrant	p < .001		p < .001	
No	43.5 (160)	56.5 (208)	49.9 (184)	50.1 (185)
Yes	59.0 (135)	41.0 (94)	32.8 (77)	67.2 (158)
Visible minority	ns		p < .05	
No	47.1 (202)	52.9 (227)	46.4 (201)	53.6 (232)
Yes	54.1 (85)	45.9 (72)	35.2 (56)	64.8 (103)
First language	ns		p < .001	
English/French	44.7 (178)	55.3 (220)	49.9 (199)	50.1 (200)
Other	58.4 (115)	41.6 (82)	30.0 (61)	70.0 (142)
Age	ns		ns	
< 30	49.7 (90)	50.3 (91)	39.3 (72)	60.7 (111)
30-34	45.3 (117)	54.7 (141)	43.7 (114)	56.3 (147)
35+	56.6 (86)	43.4 (66)	48.7 (75)	51.3 (79)
First child	ns		p = .01	
No	51.9 (137)	48.1 (127)	37.4 (101)	62.6 (169)
Yes	47.4 (158)	52.6 (175)	47.9 (160)	52.1 (174)
Perceived control	p < .05		ns	
High	40.4 (44)	59.6 (65)	46.4 (51)	53.6 (59)
Somewhat high	42.9 (48)	57.1 (64)	42.9 (48)	57.1 (64)
Somewhat low	52.3 (80)	47.7 (73)	45.8 (71)	54.2 (84)
Low	56.6 (112)	43.4 (86)	41.5 (83)	58.5 (117)
Reported awareness	ns		p < .05	
Very aware	52.9 (81)	47.1 (72)	54.5 (84)	45.5 (70)
Somewhat aware	46.2 (97)	53.8 (113)	40.6 (88)	59.4 (129)
Somewhat unaware	51.0 (75)	49.0 (72)	42.9 (63)	57.1 (84)
Unaware	42.2 (19)	57.8 (26)	33.3 (15)	66.7 (30)
Protective action	ns			
High/Moderate	52.9 (137)	47.1 (122)	-	-
Low/None	46.6 (157)	53.4 (180)		

Table 2.4 shows the results of the multivariate logistic regression models examining moderate or high levels of general concern and protective action in relation to identified explanatory variables. In the general concern model, the analysis indicates that women were more likely to report a high level of concern if they lived in Peel as compared to Ottawa (OR: 2.18; $p < .001$) , if they were in the lowest income bracket (OR: 2.99; $p < .01$), and if they reported a low level of perceived control (OR: 2.03; $p < .05$). They were also significantly more likely to report higher levels of concern if they took moderate or high levels of protective actions (OR: 1.93; $p < .01$). Variables that were not significant in the model were education, immigrant status, age, and reported awareness. The model is significant based on the chi-square test ($p < .001$) and the Hosmer and Lemeshow test (.134). The Nagelkerke R Square was used in both models to assess relative change in model fit.

In the protective action model, results show that women were significantly more likely to take several protective actions if it was their first child (OR: 1.76; $p < .01$), if they reported a high level of awareness (OR: 2.54; $p < .05$), and if they had a moderate or high level of concern (OR: 2.07; $p < .001$). They were significantly less likely to take protective actions if they had lower household income (lowest income bracket = OR: .18; $p < .001$), and if their first language was not English or French (OR: .48; $p < .05$). Variables that were not significant in the model were location, education, immigrant status, age, and perceived control. This model is significant based on the chi-square tests ($p < .001$) and the Hosmer and Lemeshow test (.737).

Table 2.4 Logistic regression models for mothers' moderate or high levels of general environmental health concern and protective action

Variable	General Concern		Protective Action	
	OR	**CI**	**OR**	**CI**
Location				
Ottawa	1.00		1.00	
Peel	2.18***	1.42-3.33	1.12	0.71-1.76
Household Income				
>$120,000	1.00		1.00	
$80-119,999	1.66*	1.03-2.68	0.49**	0.30-0.80
$40-79,999	1.31	0.72-2.35	0.51*	0.28-0.93
<$40,000	2.99**	1.40-6.38	0.18***	0.08-0.42
Education				
Graduate degree	1.00		1.00	
Bachelor's degree	0.81	0.51-1.29	1.14	0.71-1.82
College	1.05	0.58-1.90	0.60	0.33-1.11
High school or less	0.89	0.44-1.81	0.99	0.47-2.10
Immigrant				
No	1.00		1.00	
Yes	1.45	0.92-2.27	0.84	0.47-1.51
First Language				
English/French	-	-	1.00	
Other			0.48*	0.27-0.88
Age				
< 30	1.00		1.00	
30-34	0.96	0.59-1.56	1.03	0.62-1.73
35+	1.55	0.90-2.67	1.25	0.69-2.27
First child				
No	-	-	1.00	
Yes			1.76**	1.14-2.71
Perceived Control[1]				
High	1.00		1.00	
Somewhat high	0.96	0.52-1.78	1.00	0.53-1.87
Somewhat low	1.55	0.86-2.77	0.91	0.50-1.65
Low	2.03*	1.14-3.61	0.87	0.48-1.55
Reported Awareness[2]				
Unaware	1.00		1.00	
Somewhat unaware	1.43	0.66-3.11	1.25	0.55-2.83
Somewhat aware	1.23	0.57-2.65	1.67	0.75-3.75
Very aware	1.46	0.65-3.28	2.54*	1.10-5.86
Protective Action				
None/Low	1.00		-	-
Moderate/High	1.93**	1.33-3.08		
General Concern				
None/slight	-	-	1.00	
Moderate/high			2.07***	1.36-3.15
Pseudo R Square	0.159		0.202	
-2 Log likelihood	609.461		588.356	
Number of cases	484		484	

*p<0.05, **p<0.01, ***p<0.001

[1]Index based on questions related to personal control, relative importance of personal actions, and belief that specific actions that can be taken

[2]Index based on questions asking about change in level of awareness since having children, information received about environmental health hazards and specific hazards they had heard/read about.

2.5 Discussion

The principal objective of this study was to better understand the ways new mothers perceive and respond to environmental health risks to their children and the socioeconomic and geographic factors that influence their concerns and protective actions. Approximately half of the women in this study reported a moderate or high level of concern with regard to their children's environmental health, with concerns ranging from household products to extreme heat and sun exposure. Women in lower income homes tended to perceive risks to be higher, while being less likely to take steps to reduce them. Geographic context appeared to influence concern but not protective action, with respondents of Peel being more concerned than those of Ottawa, but no more likely to take protective actions.

Household products (including cleaning and beauty products) were the most commonly reported environmental health risks that the mothers were aware of, followed by outdoor risks (air, water, and soil contaminants), indoor air quality (cigarette smoke, dust) and food risks. Slightly less than half (43%) of the respondents reported taking several (three or more) actions to reduce environmental health risks, and the most commonly mentioned actions taken revolved around household products (switching from unsafe to safe cleaning and beauty products) and food (avoiding preservatives, buying organic, improving diet). The fact that protective actions against outdoor risks were almost never mentioned, despite slightly higher awareness about outdoor risks than food risks, lends support to the findings in the first phase of the project that mothers felt limited in their ability to control or protect themselves against outdoor risks (Crighton et al., 2013).

Levels of concern and protective action were low in our study with 49% reporting a moderate or high level of concern and 43% reporting taking multiple protective actions. By

comparison, Evans et al. (2002) in their study of visible minority women in New York found that most participants reported high levels of awareness of environmental risks (i.e. >95% for most identified hazards) and a similarly high percentage reported taking one or more protective actions to reduce identified exposures. The difference in findings may be explained in part by the fact that specific environmental hazards were introduced in the questionnaire in the New York study, whereas in our study they were not. As such, it could be expected that responses in our study more closely reflect actual levels of awareness and protective action and are less likely to be influenced by how respondents might perceive researchers' expectations. Not surprisingly, our findings also show that women who were concerned were almost twice as likely to take more protective actions against environmental health risks, a relationship that has been identified elsewhere (Rose, 2010; Thirlaway & Heggs, 2005).

Household income was a significant predictor of both concern and protective action, with lower income increasing the likelihood of experiencing higher concern and decreasing the likelihood of taking protective action. In the risk literature, lower income is commonly found to be associated with higher risk perception (Ho et al., 2005; Lee et al., 2005; Lemyre et al., 2006; Thoolen et al., 2008), explained by the fact that that low SES respondents may feel powerless when it comes to managing risks (Vaughan & Dunton, 2007). Correspondingly, in the descriptive data the most commonly reported factors preventing participants from taking protective action were financial constraints and a lack of control (data not shown). Similarly, the protection motivation theory posits that one's ability (or lack thereof) to take action is dictated, among other factors, by financial resources (Floyd et al., 2000).

Perceived control was found to significantly predict concern, whereby women with low perceived control were more likely to experience higher concern. These findings are consistent with the first phase of the project (Crighton et al., 2013), where it was found that women expressed more concern when they felt that particular risks were beyond their control. This has similarly been reported elsewhere (Flynn et al., 1994; Gustafson, 1998; Lemyre et al., 2006). On the other hand, awareness was found to significantly predict protective action; women who were very aware of environmental health risks were more likely to take protective actions. Again, these findings are consistent with the previous phase, in which the tendency to take action was influenced by awareness of risk information (Crighton et al., 2013). Given the influence of income, control, and awareness on concern and protective action, risk communication experts should place special emphasis on the accessibility and comprehensibility of environmental health risk information, which should target new mothers and provide affordable protective strategies when possible to ensure that mothers across all income brackets can take inexpensive protective actions. Examples of such actions may include wet-mopping to reduce household dust, using alternative cleaning products, and making safe food choices (CPCHE, 2005; see also Environmental Working Group [ewg.org]; healthychild.org).

First language was the only demographic factor that was a significant predictor of either outcome examined here; it was found that women whose first language was not one of Canada's official languages, English or French, were less than half as likely to report taking high or moderate levels of protective action. This finding points to potential language or cultural barriers for some women in accessing the information or resources required to respond to health risks effectively. The likelihood of taking protective action may be

improved if risk communication materials were available in multiple languages to accommodate parents of varying linguistic backgrounds whose first language is not English or French.

General concern varied geographically, with women in Peel being more than twice as likely to report a high or moderate level of concern compared to their Ottawa counterparts. Greater concern in Peel is consistent with our expectations given the higher levels of pollution and industrial sector activity in and around the Peel region compared to Ottawa (Ontario Ministry of the Environment, 2013), and could reflect higher perceived or actual levels of environmental health risks. The results also indicate that women in Peel were no more likely than their Ottawa counterparts to take protective action despite their higher levels of concern. These findings further illustrate the potential challenges for risk management and communication strategies in regions that have a reputation for elevated pollution levels and that are ethnically, culturally, linguistically, and socioeconomically diverse.

Interestingly, being primiparous was not found to play a significant role with regard to concern, despite our expectations that first-time mothers might be more inexperienced and thus more concerned about the well-being of their new baby. However, primiparity was found to increase the likelihood of taking protective action. In a Swedish study by Lagerberg and Magnusson (2013) comparing utilization of health services, stress, and social support among primiparous and multiparous mothers, primiparous mothers reported fewer time constraints, less stress, more social support, and better access to child health services than their multiparous counterparts. These findings may explain why the primiparous mothers in our study were not more concerned than multiparous mothers, as such factors could be

expected to reduce their overall levels of concern, including concerns about environmental health risks that might be expected among first-time mothers. It may also explain their increased likelihood of taking protective action. Our findings indicate that compared to first-time mothers, multiparous mothers facing reduced support and increased time constraints may require different risk communication and public health strategies to incite protective action.

A number of variables were found not to be significant in the models. Education was not a significant predictor of concern or protective action. In the case of concern, previous research shows that lower levels of education are associated with greater risk perception (e.g. Krewski et al., 2006; Lemyre et al., 2006). Although further research may be required to understand the influence of education in this population, it is possible that among mothers more education leads to increased risk awareness, diluting the typical protective effect of education. This has similarly been found in a study of high risk pregnancies by Papiernik et al. (1997), in which women with higher education levels were more likely to be more concerned for themselves and their children (as cited in Lee, Ayers, & Holden, 2012). Age was also not found to significantly influence concern or protective action, unlike what has been found elsewhere (Krewski et al., 2006; Otani, Leonard, Ashford, Bushroe, & Reeder, 1992). This could be explained by the relatively small age range of the sample, which is limited to women in their childbearing years. Finally, the immigrant status and visible minority variables were not found to be significant in either model, despite findings to the contrary in the literature (Brody et al., 2008; Marshall, 2004). This could indicate that in the Canadian context it is not immigrant status or visible minority but rather language that acts

as a barrier to information about risks and protective actions, or rather that language behaves as a proxy variable for immigrant status and cultural background in this study.

This study has some limitations that should be outlined. First, the study focused only on two Ontario PHUs, therefore caution must be taken in generalizing the findings beyond these locations. In addition, the sample is not likely to be representative of the new mothers in these areas given its size and the self-selection nature of the sample; it is possible that the women who agreed to participate in the telephone survey do not represent all women who have recently given birth, but rather represent women who have certain characteristics, opinions, or knowledge. Related to this is the fact that women considered at risk for post-partum depression or who were experiencing other significant problems were not asked to participate by the public health nurses during the HBHC call, and thus were excluded from the study. Finally, financial and time constraints prevented us from administering the survey in more languages than English and French and may have limited the inclusivity of the sample, particularly given the linguistic diversity of the study population.

2.6 Conclusion

The purpose of this study was to examine the ways new mothers perceive and respond to environmental health risks to their children, given their role in managing family health and the challenges they typically face compared to men in terms of income and control. Using a telephone survey and quantitative analysis, it was found that income significantly influenced general concern and protective action; lower income mothers were more concerned about environmental health risks, yet they responded with fewer protective actions. Women who faced language barriers were also less likely to take protective actions. This research

contributes to the understanding of risk perception and protective action in a largely understudied population and the findings have practical implications for risk management and communication strategies targeting pregnant women and new mothers. There is a need to recognize the unique barriers that mothers face in accessing information due to income, language, control, and awareness, and affordable and feasible protective solutions should be communicated to mothers across socioeconomic and cultural contexts to deal with issues of inequity. Although risk communication programs are beneficial in the short-term, higher level change is also needed to protect mothers in the first place, including policies banning harmful and unnecessary chemicals found in many household and food products. Further research is required to investigate the nature of the risks concerning mothers, the barriers preventing them from taking protective action, and the best ways of communicating risk information to new mothers. The next phase of this study involves qualitative, face-to-face interviews with a sample of the respondents who completed the questionnaire and begins to address these questions, taking a closer look at women's concerns, protective actions, information sources, and preferences regarding when and from where they would be most receptive to information about environmental health risks.

Acknowledgements

The authors thank the staff at Peel Region and Ottawa Public Health Units for their support of this project and assistance with recruitment, as well as all of the new mothers who participated in the study. There are no conflicts of interest to declare.

Funding

This research was supported by the Social Sciences and Humanities Research Council (SSHRC) Standard Research Grant [410-2009-0951], and the Ontario Graduate Scholarship (OGS) program.

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CHAPTER 3

Environmental health risk perceptions, protective actions, barriers, and information sources: A qualitative study of mothers in Ottawa, Canada

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Manuscript in preparation for submission to the journal BMC Public Health

Abstract

Environmental health risks are increasingly reported in the media and have been associated with a broad range of immediate and long-term poor health outcomes. Children are more exposed and vulnerable than adults to environmental health hazards due to a variety of physiological and behavioural factors. Despite the responsibility mothers typically bear as primary caregivers, little is known about how they perceive and negotiate these risks in their day-to-day lives. To better understand mothers' risk perceptions, protective actions, and information sources, interviews were conducted in Ottawa, Canada with a subsample (n=15) of respondents from a previous telephone survey. It was found that mothers' concerns and protective actions varied widely, but there was a commonly reported perception that mothers should automatically become more concerned and take protective actions once they have children. However, financial barriers and perceived lack of control sometimes hindered the ability to take protective action. When actions could not be taken, many mothers may have used emotion focused coping such as choosing to ignore risk information. The most common source of information was the Internet, but many mothers expressed some mistrust in it. They suggested that healthcare professionals should provide information about environmental health risks during prenatal checkups. This study contributes to our understanding of risk perceptions and protective actions among mothers, and has implications for the development of effective, population-specific risk communication strategies and public health programs.

Keywords: risk perception; protective action; mothers; environmental health; coping

3.1 Introduction

Environmental health risks are increasingly reported in the media, ranging from contaminants in food and air to toxic chemicals in everyday household products. Despite overall improvements that have been made to health outcomes and healthcare in Canada, the rates of numerous chronic diseases such as coronary heart disease and type 2 diabetes are increasing, and there is a growing body of evidence to indicate that this rise and other adverse health outcomes can be at least partially attributed to environmental exposures (Nieuwenhuijsen et al., 2013; Schlotz & Phillips, 2009; Stillerman et al., 2008; Tyshenko et al., 2007). Children are more exposed and more vulnerable to environmental hazards than adults due to physiological and behavioural factors, making it particularly important to understand how caregivers perceive and negotiate these risks (CPCHE, 2005; Le Cann et al., 2011; Tyshenko et al., 2007). Risk messages targeting mothers, who are often the primary caregivers, are meant to inform and evoke an adequate level of concern to take protective actions to reduce exposures. However, not all mothers are equally capable of taking protective action; for example, some individuals may face barriers, such as low income, while concomitantly facing higher exposures to environmental health hazards due, for example, to adverse housing conditions (Chen et al., 2002; CPCHE, 2005; Marshall, 2004; Matthews & Gallo, 2011). Although risk perception has been widely studied in the general population, little is known about the ways mothers perceive and respond to environmental health risks, and how this may be influenced by socioeconomic and geographic contexts. Building on a previous quantitative survey of new mothers in Ontario (Chapter 2), this study employs a qualitative approach to examine in more depth the themes and questions that emerged from the previous study with women who, approximately two years after their

initial participation, are now mothers of toddlers. This study provides insight into the risk perceptions, protective actions, barriers, coping mechanisms, and information sources of mothers in Ottawa, Ontario, Canada.

3.2 Context

Childbearing and childrearing are complex experiences that are affected by the dominant discourses regarding gender roles. Women are commonly expected to fulfill established gender roles, including bearing much of the responsibility for family health and day-to-day household decision-making (Ho et al., 2005; Thirlaway & Heggs, 2005), including shopping, cooking, and cleaning. These duties involve important choices about what food and household products are purchased, which have implications for potential hazard exposures (Mackendrick, 2011). This can put tremendous pressure on pregnant women and mothers to limit risks to their children, and to "discipline virtually all dimensions of their bodies and behaviours (what they eat and drink, where they work and recreate, when and how they exercise, and so forth) in accordance with elaborate, ever-proliferating, ever-changing rules of risk minimization" (Kukla, 2010, p. 324).

Children are more exposed and more vulnerable to environmental health hazards than adults (CPCHE, 2005; Le Cann et al., 2011; Schlotz & Phillips, 2009; Tyshenko et al., 2007). They eat, drink, and breathe more than adults relative to body weight; breathe at a lower height than adults, where more dust and contaminants are found; and ingest more contaminants by engaging in hand-to-mouth exploration and by consuming a much less varied diet (CPCHE, 2005; Le Cann et al., 2011; Tyshenko et al., 2007). They are also exposed to contaminants prenatally through the placenta (Schlotz & Phillips, 2009;

Stillerman et al., 2008; Tyshenko et al., 2007). As such, environmental health risks could be expected to be particularly concerning for mothers and pregnant women given their traditional roles as primary caregivers. Mothers may want to take action to protect their children from such risks, yet this can be made difficult by a lack of information or resources needed to take precautionary or protective measures (Mackendrick, 2011; Thoolen et al., 2008).

The ways people perceive and respond to risks have been shown to vary across gender, income, education, age, and a variety of other factors. Lee et al. (2005), Krewski et al. (2006), and Lemyre et al. (2006) have found that, in a Canadian context, individuals who are older, less educated, lower income, and female tend to perceive risks to be higher than their younger, more educated, higher income, and male counterparts. It is suggested that these findings relate to the importance of sense of control and unequal power relations experienced by marginalized populations such as women, ethnic minorities, and low income individuals (Bickerstaff, 2004; Brody et al., 2008; Flynn et al., 1994; Gustafson, 1998; Krewski et al., 2005; Lemyre et al., 2006; Marshall, 2004).

Several theories have been developed to understand the ways people cope with perceived risks. According to Lazarus and Folkman's (1984) *psychosocial model of stress*, if an individual cannot use *problem focused coping* (directly taking protective action to reduce a risk), they may rely on *emotion focused coping* (using psychological defence mechanisms to deal with feelings of distress and vulnerability). *Protection motivation theory* (Floyd et al., 2000) also focuses on coping mechanisms related to direct action or inaction; according to this two-process theory, the benefits of action and inaction are weighed against the severity of and vulnerability to the risk (threat-appraisal), and one's ability to take action and the

likelihood that the action will successfully reduce the risk are weighed (coping-appraisal). Risk perception has been found to influence problem focused coping; for example, some worry has been found to encourage protective response, while too little or too much worry reduced the likelihood of taking protective action (Thirlaway & Heggs, 2005; Wood & Della-Monica, 2011). Furthermore, barriers related to time and financial resources can seriously hinder one's ability to take protective action to reduce environmental exposures, even when the risks are understood and preventable (CPCHE, 2005; Harvatt et al. 2011; Mackendrick 2011; Thoolen et al., 2008). When individuals perceive risks to be high but are unable to take protective actions due to financial or other barriers, they may rely on emotion focused coping to relieve distress. For example, individuals who experience *cognitive dissonance*, for instance, an awareness of both the benefits of organic food as well as one's inability to afford it, may exhibit feelings of unrealistic optimism regarding one's vulnerability to the consequences of consuming non-organic food in the long-term to cope with clashing notions (Festinger, 1957; McMaster & Lee, 1991). Lazarus and Folkman (1984) similarly theorize that when an individual cannot take direct action to reduce a risk they may rely on denial of their vulnerability to the risk to alleviate the associated stress.

Despite the risks children are exposed to and the challenges mothers face in protecting them, very few studies have looked at the ways mothers, specifically, perceive and respond to environmental health risks. Therefore, a multi-phase study was developed to begin addressing this gap in our understanding of risk perceptions and protective actions of new mothers. The first phase of the study involved interviews with new mothers in Peel Region and Ottawa, Canada (Crighton et al., 2013). Levels of concern and protective action varied widely. Risks within the home were seen as controllable and thus generated less concern,

while risks outside the home were seen as less controllable and evoked more concern. Some mothers used emotion focused coping to deal with concerns; for example, optimistic bias was seen in mothers who reported that their children were less at risk than other children in similar circumstances. In the second phase (Chapter 2), a telephone survey was conducted among 606 new mothers in the two study sites. The findings suggest that inequities exist whereby some individuals, particularly those who face barriers related to income, language, and control, were more likely to be concerned about environmental health risks and/or less likely to take protective action.

Building on the previous quantitative study (Chapter 2), this study employs a qualitative approach to provide depth and insight into the findings from the survey and to explore questions that emerged. Barriers to taking action needed to be examined in more depth, as less than half of the mothers took multiple protective actions in the survey, and it was unclear how they coped when they could not take action. Furthermore, in the survey very few mothers reported receiving environmental health information from healthcare professionals, yet many would have preferred to receive it from them. Thus, more research was needed regarding mothers' information sources and the best way forward for public health education programs, especially given the relatively low levels of concern and awareness found in the previous study. This study examines concerns, protective actions, barriers, and information sources in more depth and through the perspective of mothers of toddlers rather than newborns.

3.3 Methodology

This study is part of a larger, mixed-method research project. Following the previous two phases in which new mothers and public health key informants in Peel Region and Ottawa Public Health Units (PHUs) were interviewed (Crighton et al., 2013) and new mothers in the PHUs were surveyed (Chapter 2), this current phase employed qualitative, semi-structured, face-to-face interviews with 15 mothers living in Ottawa, Ontario, Canada. This research was approved by the University of Ottawa Research Ethics Board, the Ottawa Public Health Ethics Board, and it meets the ethics criteria of Peel Public Health.

3.3.1 Data and sample

The women who were interviewed were recruited as a sub-sample of the participants from the quantitative survey (Chapter 2); at the end of the questionnaire, respondents were asked whether they would be willing to participate further in the study. Eighty-one percent of the respondents from Ottawa agreed to be contacted about further participation. From this group, a purposeful sampling technique was used, starting with participants in the lowest income and education groups in an effort to ensure that mothers across SES levels were well represented in the sample. An important limitation of our previous work was the underrepresentation of low SES individuals (Crighton et al. 2013; Chapter 2). The women were contacted by telephone and interviews were arranged with those who agreed to participate.

Semi-structured interviews were conducted using an interview guide. Themes that were explored included: home life; concerns about environmental health risks in indoor and outdoor environments as well as in everyday products; protective actions taken in response

to concerns; sources of environmental health risk information; environmental inequity[1]; and socioeconomic and demographic characteristics (see Appendix 2). The term 'environmental health risk' was purposely not defined by the interviewer at the beginning of the interviews, leaving the participants to first discuss what they believed to be examples of environmental health risks without inducing bias or raising alarm. Interviews were conducted in either English (n=13) or French (n=2), at locations of the participants' choosing, either in their homes (n=10), their workplaces (n=4), or at the University of Ottawa campus (n=1). The interviews took place between May 31 and July 22, 2013, between a year and a half and two years after their initial participation in the survey. Taking into account the time constraints of mothers with young children, interviews were kept short, lasting between 25 and 40 minutes.

The participants' ages at the time of the interviews ranged from 23 to 38, with an average of approximately 30 years. For ten of the mothers this was their first child, and three participants were pregnant again at the time of the interview. All but one of the participants had a partner who they lived with and were either married, engaged, or common law. Two of the mothers were African immigrants, the rest were white and born in Canada. The education levels of the participants ranged from high school or less (n=3) to PhD (n=2), with the rest of the participants having completed college (n=6) or university (n=4). Combined annual household incomes ranged from $10,000 to $140,000, with six participants reporting household incomes under $60,000 and five over $100,000. All of the participants lived outside of the downtown core, in suburban (n=12) or rural (n=3) dwellings.

[1] Environmental inequity was defined during the interviews as the idea that some groups of people are more exposed to environmental health risks because of social or economic status, race, or where they live. The participants were asked whether they thought this concept applied to them and whether their children have been or are more likely to be exposed to environmental health hazards than other children (Appendix 2).

3.3.2 Data coding and analysis

Interviews were digitally recorded with permission and transcribed verbatim, and the transcripts were entered into NVivo (v.8) for coding and analysis. Pseudonyms were selected by participants at the time of the interview and used to ensure anonymity. The process of coding and organizing the data was non-linear, with multiple rounds of coding being necessary as new themes emerged. Three types of coding were used during analysis to identify and make links between themes: first, open coding was used to label paragraphs of data; second, axial coding was used to agglomerate broadly themed nodes and break them down into more focused child nodes; finally, selective coding was used to identify and refine the themes and data most relevant to the research objectives (Strauss & Corbin, 1990). Coding was undertaken by the primary author in consultation with the co-author.

3.4 Findings

Several key themes were identified during analysis regarding mothers' concerns and protective actions, barriers and coping strategies, and information sources about environmental health risks, all of which varied to some extent across the sample.

3.4.1 Mothers' concerns about environmental health risks

Awareness of and concern about environmental health risks varied widely within this group. While many mothers did not initially have a strong sense about what the term 'environmental health risk' might mean, their memories may have been triggered as the interviews progressed and they discussed their concerns. Almost all of the mothers reported becoming more concerned about environmental health risks after having children, to varying degrees.

3.4.1.1 Types of concerns

The types of concerns that were raised ranged from outdoor hazards to risks in household products and food. Air quality was a commonly mentioned outdoor concern: Sue and Patricia both mentioned proximity to a large roadway, and several other mothers mentioned air quality and pollution from garbage. For Isabel, the most pressing concern was exposure to second hand cigarette smoke, both indoors and outdoors:

> My biggest thing is smoking. I can't stand walking down the strip mall and everybody's outside smoking and we have to breathe that in all the way, that really drives me crazy. I don't like that, like I'm pushing her in the stroller and all of a sudden you get a whiff of smoke, guaranteed that just went in her lungs […] I don't want my kids breathing it in.

Another outdoor concern mentioned by multiple women was water quality, with issues related to drinking water (tap and well water) and to water pollution at the beach both being mentioned. Several mothers mentioned the sun as a concern and two mentioned power lines. Both Kristen and Diana expressed concerns about pesticides being sprayed near their rural homes, and Diana also mentioned the possibility of oil spills from oil delivery trucks that frequently use her road.

Many of the mothers expressed concerns about chemicals in everyday household products, for example:

> A lot of toxins in our cleaning supplies, plastics in the house, anything, everything […] just anything we use in our day-to-day lives these days, from things like hairspray or face wash to their shampoos […] it's coming out in the news that they're just so full of awful things but, there's not a lot of choice, you know? (Kristen)

The most commonly mentioned concerns about food revolved around preservatives and additives. Sue said that she was even concerned about ingredients in food products from baby companies that did not previously include them:

> You have to even read the labels on baby products […] they start adding

> sugar and whatnot and, other things as well, and so I found that even the same company where I thought I wouldn't have to check it initially, now I'm checking even their labels 'cause they add stuff to it.

3.4.1.2 How much concern is enough? How much is too much?

When discussing concerns about environmental health risks, many of the women indicated that mothers should automatically become more concerned once they have children, and want to take steps to protect them that they would not necessarily take to protect themselves if they were childless:

> I think that's normal with most mothers as soon as they have their baby they're like, 'ah, I have to protect this little thing.' (Erica)

> I do think about it more, like now that I have him to be concerned about […] whereas before I wouldn't care. Like if it was just me eating it or washing with it, I probably wouldn't care. (Cassidy)

In contrast, one mother spoke of rejecting the high expectations that society, and in particular other mothers, place on her:

> All the play groups I've gone to, they talk about what you can and cannot feed your child, let them play with, how you're supposed to live, bacterial wipes here, there, everywhere. I'm not that parent […] I think it's crazy to worry about it. (Bailey)

While most of the mothers expressed some level of concern about environmental health risks, even among the most concerned participants a theme emerged about the stigma of being too concerned or too 'paranoid'. For example, Mary spoke of her pregnancy and her constant awareness of potential consequences of her choices in terms of paranoia:

> You know, diet, things that you should avoid eating while you're pregnant, no alcohol, no smoking, no drugs. It was awful because I was so paranoid, I would not take a cough drop if I had a cold and I didn't want to take anything unnecessary.

Similarly, after Leslie's daughter was born, she quickly became aware of many environmental health risks and equated her sudden concern with going 'crazy':

> I kind of went through a crazy stage, and I just figured that everything in the house was toxic. Everything, even the radiation from her baby monitor started to make me worry […] I really went crazy for a good couple months and threw out like the whole house.

Several other women talked about not being too extreme when it came to their concerns, about finding the balance between having some concern but not too much, and about making compromises between healthy and unhealthy choices. For example:

> You just have to not get too crazy. I mean you're not going to live under a rock or put a tinfoil hat on or anything, but you have to try at least to protect your kids. (Kristen)

Not surprisingly, it was overwhelmingly the mothers, and not the fathers, who were concerned about risks in this sample. Several women described their partners with phrases such as 'laid back' or 'go with the flow,' and almost all of them said that their partners were less concerned than themselves or not concerned at all. For example, Sarah said that her partner was not concerned to the same extent as her, and she bore the responsibility for her family's environmental health:

> If I didn't sort of spearhead a lot of the things he probably wouldn't think too much about it.

3.4.2 Compromise as a component of protective action

All of the mothers said that they took some actions to protect their children from some of the environmental health risks discussed, ranging from very few to many actions incorporated into daily life. Despite some mention of protective actions related to outdoor risks, such as frequently testing well water and being vigilant about sunscreen, the participants reported taking much more protective action when it came to household products and food risks. To address concerns about risks associated with household products, several mothers switched to safer beauty and cleaning products:

> I've started buying organic wash for them and I really don't use very much on myself anymore, as far as moisturizers and face wash and things like that and expensive shampoos and, no it's not worth it. So those are thing I've cut down on, also cleaning supplies like I won't use the really crazy ones that are super toxic. (Kristen)

> We've switched to natural cleaning products […] I don't use a lot of chemicals or anything. Baking soda, vinegar, that kind of stuff. […] I would never, I couldn't use it. We had like Clorox or something for the bathtub and I won't use that. (Sue)

On the other hand, Bailey brought up the idea that storing cleaners out of reach of children is an important way to protect them from toxic products, specifying that she uses big name products that contain toxic chemicals but that they are all put away. Isabel also uses regular cleaning products, but keeps them in locked cupboards and tries to protect her children from them:

> When I actually clean the bathroom I try to close [the door], I don't like to close the door and breathe it all in myself, but it keeps them out of the washroom and I just put the fan on in the bathroom and keep them out until the smell's gone.

Similarly, Isanancy uses specialized cleaning products with strong chemicals for certain household tasks, for example cleaning wood or glass, but she makes sure that her daughter is in her room sleeping and that she uses less strong smelling options. Many mothers expressed a need to balance the use of safe products with those that they believe clean more effectively, mentioning that they switched some products, such as those that their children might come into direct contact with, but not others. Specifically, several mothers mentioned that they did not switch to non-toxic bathroom cleaners for fear that they might be less effective. For example:

> I don't use a lot of house cleanser stuff like I pretty much just use vinegar and water and baking soda and I do use a few toilet cleaners 'cause I just find the toilets don't get clean if you use like the basically vinegar and baking soda. (Sarah)

To take protective action against food risks, many of the women said that they avoided processed foods when possible. For example:

> We do cook, I would say, 95% of her food. She doesn't have a lot of like, boxed stuff, which is my main concern, I don't like feeding children stuff like that […] It's that I don't know what's in it. (Erica)

Sue stopped buying products targeting children and instead provides meals and snacks that she and her partner eat, avoiding incomprehensible ingredients and the middle aisles, where most processed foods are found, while grocery shopping. Other mothers said that they largely avoid preservatives and processed foods, but there are sometimes exceptions given children's preferences. For example:

> We hardly have any sort of additives and preservatives in our food […] the kids it's harder 'cause they don't like as many things so like we'll have canned mushroom soup sometimes and things like that. I try to make the healthier alternatives that have the ingredients that I know, and we don't eat at places like McDonalds. (Lucy)

Several women said that they try to buy organic produce when they can. However, with food choices as well as with risks outdoors and in household products, numerous barriers to taking protective action were identified.

3.4.3 Barriers to taking protective action: control and money

Despite concerns about air quality, several women expressed that there was little they could do to protect themselves and their children from exposures, which they felt were beyond their control. For example:

> Well, in terms of the air pollution, there's really not much I can do. I mean, the best thing we could do is move and we're just not able to because of financial reasons. (Patricia)

Diana, a rural resident, also felt that there was little she could do to protect her family from outdoor risks related to pesticide spraying and potential oil spills near her home:

> Yeah like I mean there's nothing I can do for when the farmers are spraying their stuff, or when, you know, if there's a spill it's just a matter of trying to take us out of the situation.

When it came to household products, Leslie also faced a barrier in the form of a lack of choice; she felt that there are not always obvious safe options for products and sometimes one has to choose the lesser evil:

> A couple of her toys I threw out because I saw on the Fisher Price website they were recalled for lead, it's like, what is going on? […] I am very aware of it and it does scare me, I don't like any of her plastic toys to be honest but what do you do? […] But I mean I can avoid the worst ones. Can you avoid them all? No. But at least it's something. (Leslie)

Some mothers reported buying organic fruits and vegetables when possible, but cost was a barrier preventing many of the mothers from doing so all or any of the time. Although Sarah said that she washes her produce rather than buying organic because she heard that buying organic is not necessary, particularly for fruits and vegetables with peels, cost is the main factor preventing her from buying organic produce:

> Even some things that I probably should buy organic I just, I don't know, figure wash it. It is expensive and on one income you have to sort of, you can't always do what you'd like to do necessarily.

Similarly, Mary said that she stopped buying organic because of cost, because she washes her produce, and because her sons are not as young anymore. In these cases, cost was a barrier so they took the next best protective action that they could, which was washing produce well.

3.4.4 Emotion focused coping

3.4.4.1 Sometimes ignorance is bliss

For some mothers, avoiding information about environmental health risks or ignoring risks that previously worried them were ways to cope with concerns. Two of the mothers

said that they do not watch or read the news because it is 'too depressing' (Sarah) or 'scary' (Sue). Several other mothers ignored risk information or their perception of susceptibility to risks. For example, Cassidy said:

> It's an old house so I'm sure there's some health issues with it, but I choose to ignore it.

Similarly, Bailey appeared to be overwhelmed by risk information and competing priorities, choosing instead to ignore certain risks and to avoid receiving information:

> I don't really feel like there's a risk but, there probably are. […] I think ignorance is bliss. I know that it seems ridiculous, but I can't hold the weight of the world on my shoulders when it comes to that stuff, I do the best I can. […] I chose not to do any prenatal […] I didn't want to hear it I guess.

Sarah also mentioned that radon was a concern for her when she had heard that it was prominent in her neighbourhood and that she had planned to get her house tested, but that had 'gone to the back of our minds a bit.' Mary also coped with risks that used to concern her by deciding that they were no longer concerns, becoming less anxious as her children get older and coming to accept that she can't control all risks:

> I used to worry about sand in parks, and I'd worry about them getting their hands dirty and then the hands invariably go in the mouth and, I still don't like it and sometimes I'll just pretend it's not happening, but my mother and my mother-in-law both say that a little bit of dirt is good for them and so I let them now do things that I would have had a conniption about before.

Kristen was very concerned about the pesticides that used to be sprayed near her house and that the medical issues affecting her siblings and another woman who grew up on her street may be caused by these lasting contaminants. However, when asked if she would move to distance herself and her family from the area, she said no and instead managed her concern by taking protective actions elsewhere and focusing on the lack of concrete proof:

> No I don't think I'd consider moving at this point but I believe all the

> little things that we're doing to try to offset that I'd say is enough for me right now until there's, I mean there's no proof right.

Another way to reduce concern and ignore perceptions of vulnerability is optimistic bias. In the following example, Clémentine said that she faces issues of environmental inequity (i.e. higher exposure to environmental health risks) due to the colour of her skin, but later denied that this could make her children more at risk than other children and said that, in fact, they are not at risk at all:

> Oui, ça [l'iniquité environnementale] peut s'appliquer à moi aussi. Parce que, comme je le dis souvent, il y a le problème de race aussi. Il y a le problème de race qui fait que souvent je peux demander de l'aide, et l'aide tarde à cause de ma peau.

3.4.4.2 Childrearing as we were raised

Several mothers reasoned that they ignored risk information and did not take protective actions because they were choosing to raise their children as they were raised, drawing on their own past experiences with similar hazards that may not have had noticeable repercussions. For example:

> We grew up using Clorox at home […] I obviously survived my childhood with that stuff all accessible but you just show them not to play with them, keep it high enough 'til they're old enough to know […] There's too much to worry about. People these days worry about every little thing and I personally wouldn't change my childhood for anything, so why would I want her to have the opposite? […] I want her to grow up the way I grew up, I want her to grow up healthy, happy, I don't want her to worry too much. (Bailey)

> I mean we don't buy organic or anything, we're happy like, I ate pesticide food when I was a kid and I'm okay, so I'm not concerned about it. (Patricia)

It is possible that this concept of having 'survived' one's childhood and wanting to raise children in the same way is a method of coping with an inability to take protective actions, due to financial barriers or a lack of control, or it is possible that it is the result of skepticism

of modern risks and one's susceptibility to them. A different perspective was presented by Kristen who questions whether 'childrearing as we were raised' is a good idea and instead suggests the need for a more precautionary approach to using everyday products, recognizing that while we may not experience immediate repercussions, we do not understand the long-term risks :

> I mean, for a while it's kind of like, well we've been using them for our whole lives and we're okay, but you don't really know the extent of the damage it's doing or the long-term damage yet […] it's not worth it.

3.4.4.3 Where you live matters

A distinction in risk attitudes between rural and suburban residents emerged from the data, with rural mothers believing that they are less exposed to environmental health hazards than those who live within the city. Kristen, who lives rurally, uses downtown as an example of an area that might face more environmental health risks, despite her previously mentioned concern about the pesticides and pollution in her area:

> I'm sure that there's different areas all over the city that are more toxic for different reasons, like maybe near the dump or where they dispose of the toxic things that we have, paint and all that stuff […] I would say people maybe downtown have more, you know, just all the pollution. There seems to be a lot more concentrated in one area, like a lot more people so a lot more garbage, a lot more disposing of things.

Cassidy, who also lives in the countryside, reiterated this idea:

> We live on a farm so, dust doesn't bother me, dirt doesn't bother me […] I mean there's the pollution of everywhere, but we're in the country so it's way less than if we lived in the city […] I like where I am, I consider myself to be lucky and it's a healthy place to be, whereas like I think, okay environmental, I could be worse if I lived in a big city.

Like Kristen and Cassidy, Diana lives in a rural area and felt that location could be a more important factor than SES when it comes to exposure; that people with higher SES who live in the city are likely to be more exposed to pollution than she is in the country. On

the other hand, Isabel lives in an Ottawa suburb and started out by saying that if she lived in a rural area she would probably face less exposure to environmental health risks, but that she is exposed to fewer risks than if she lived downtown:

> Because we don't live in like a factory area or anything like that so there's not like extra exposure, but I'm sure there's a lot. Like there are busses, there's a lot of cars, there's all that kind of stuff […] I'm sure if we lived downtown it's probably worse.

The idea that where you live matters for determining risk was found to go beyond simple urban-rural distinctions; Mary, who lives in one of Ottawa's suburban areas, used the Greater Toronto Area (GTA) as an example of a riskier environment. Like Diana, she believed that there are other children more exposed than her own due to location, regardless of whether or not they have higher SES.

3.4.5 Sources of environmental health risk information

3.4.5.1 Lots of information, but who can I trust?

While mothers experience many competing time demands, it is important to raise environmental health awareness during the early, most vulnerable stages of children's development. The participants were asked questions about their most commonly used and trusted information sources. They discussed many different sources of information about environmental health risks, including the news, radio, prenatal books or classes, friends and family, and other mothers. The most commonly mentioned source of information was the Internet, including general *Google* searches, specific parent or environment websites, government websites, and academic journals. However, a theme that often arose during the interviews was the trustworthiness of information sources, and many of the women expressed some mistrust in the Internet:

> I read the Internet but I don't know how much I trust everything on there

> because I know there's a lot of misinformation out there. I guess you could say it is my most trusted [source] but I read a variety of different opinions on one subject, just to try to form my own opinion rather than taking everything for face value. (Erica)

> I mean there's a lot of things online that are scary like people write things that are meant to scare people, so you have to take it with a grain of salt, do your own research about it, but definitely anything you can read online you don't believe it right away. (Kristen)

Consequently, many mothers felt the need to cross-reference information from a variety of sources for reliability. In addition to the mistrust in information, the volume of information on the Internet can make it particularly overwhelming:

> I think it's too easy to access. I think you can easily, for a new parent, become overloaded with some of the information out there especially if you start to use the Internet and Google, for instance. So I think there's a lot of it. It's easy to access, but then it's trying to weed out and figure out what is reliable information and what might not be. And what is maybe skewed to bias certain products and what's not. (Diana)

Several other mothers also doubted the trustworthiness of solutions provided. Diana questioned whether they are reliable or 'a company gearing me towards buying something.' Mary also mentioned that there are 'often conflicting recommendations.' Similarly, Cassidy doubted the trustworthiness and the motives of solutions provided by certain sources:

> I always find I'm skeptical of what people are saying. If they say 'oh the chemicals in this product are bad,' but then how do I know who's saying this, and is it the other company?

Several mothers also expressed mistrust in the government's information and ability to protect us from environmental health risks. For example:

> You do sort of just trust what the government's saying and they're regulating things so you kind of think well, if it's being sold there they wouldn't sell us something that's going to kill us, right? But they do. (Kristen)

Lucy, who did not fully trust the government either, did not let that preoccupy her:

> There's always that sort of concern that we're getting misled with

> information just because people can say anything they want to, especially like, the government can say anything they want to […] I sometimes think about that but I don't lose any sleep over it.

Several other mothers who also expressed mistrust in the government said that they still use government sources to cross-reference with other sources. Conversely, Erica, who was skeptical of information found on the Internet, said that she prefers and has more trust in government sites than other online sources.

3.4.5.2 Where should information be coming from, and when?

The majority of the mothers felt that the best time to receive information about environmental health risks would have been during their pregnancy. According to these women, such risks would not be of sufficient concern before pregnancy, and after the pregnancy there are time constraints associated with having a new baby and returning to work:

> If you send it [information] to them before, it's not really a concern. They don't have kids, they don't care. When they're pregnant, that's when you start doing all the planning and the reading and the information-gathering. And then when they're born, you don't really have that kind of time. (Sue)

Some women also said that they could still make changes to protect the fetus if they were made aware of risks while they were still pregnant, rather than after the baby was born:

> [During pregnancy] would be a good time to have that information 'cause then before the baby is born you can help make those decisions and make sure you're not doing anything detrimental while you are pregnant. (Diana)

> [If] I would have known about the radiation during pregnancy I would have been able to protect myself as opposed to finding out about it when she's 3 months and realizing, well the whole time I had my computer on my lap, my phone near me […] And if you know about that then you can just not do it! And then you don't have to feel guilty and beat yourself up when you know about it when it's too late, 'cause that's the worst. (Leslie)

Several women also said that receiving information before a pregnancy even began would be beneficial so that women could be aware and prepare themselves ahead of time. However, most mentioned that it would be difficult to inform people before it was a priority for them. On the other hand, one mother said she would have been 'most receptive to receiving that information' (Erica) when her baby was newborn, because that was when she was the most concerned. Women overwhelmingly said that the best source of this environmental health risk information would be from healthcare professionals during pregnancy, whether it was directly from family doctors, obstetricians, or nurses during appointments or through pamphlets, information packages, magazines, email newsletters, or a specific course. However, most of the women also specified that they did not receive information about environmental health risks from their healthcare providers. For example:

> You kind of gotta know what questions to ask […] they don't necessarily give you things that they don't feel are particularly relevant. Like if you've got a newborn home they're going to cover a b and c first. (Rose)

Those believing information should be provided before pregnancy suggested it be taught in school programs (e.g. secondary school), and those who would have preferred receiving information after pregnancy suggested it come from public health nurses during at-home visits.

3.5 Discussion

Within the sample, there were wide ranging levels of awareness and concern about environmental health risks. Hazards that raised concern ranged from outdoor air pollution, to toxic chemicals in household products, to additives in foods. It is interesting to note that although concern about germs was commonly reported in earlier research (Crighton et al.,

2013), which was conducted shortly after the 2009 H1N1 flu scare in Canada, germs were not identified as an environmental health risk by the participants in this current study. This difference illustrates the importance of current events on influencing risk perceptions; according to the availability heuristic, people perceive risks to be more likely if one has recently been widely publicized in the media (Keller et al., 2012).

The idea that women should automatically be more concerned about risks when they become mothers arose frequently in the interviews, yet so did the notion that there was a certain level of concern that was acceptable, beyond which one could be considered 'paranoid' or 'crazy'. This need to find a balance between not enough and too much concern puts further societal pressure on women to adhere to certain expectations for 'good mothering' (Knaak, 2010; Kukla, 2010). Further, the expectation that mothers should be acutely aware of environmental health risks did not extend to fathers, as nearly all the women expressed that their partners were less concerned or not concerned at all. This is perhaps not surprising, as mothers most commonly carry the responsibility for managing family health as primary caregivers. (Ho et al., 2005; Mackendrick, 2011; Thirlaway & Heggs, 2005). In a few cases, the mothers indicated that as their children aged they became less concerned and perceived them to be less vulnerable to environmental health risks. This could be explained by increased confidence felt by the mothers in situations where their children typically experienced good health.

Many mothers indicated that they were able to take protective actions in response to some of their concerns about risks related to household products and food by, for example, using safer cleaning products or avoiding processed foods. However, despite concerns about outdoor risks being mentioned, taking protective actions to reduce these risks was more

difficult. Several women felt that outdoor risks were beyond their control and that there was little they could do to protect themselves and their children from them. It was previously found that this lack of perceived control regarding risks outside the home evoked greater concern (Crighton et al., 2013). Lack of control related to financial barriers was also mentioned by several mothers, particularly related to the inability to afford organic foods or alternative household products, and the inability to move to another location.

Emotion focused coping may have been relied upon to assuage the distress related to concern and the inability to take protective action. Several women coped with what they considered to be an overwhelming volume of risk information by consciously choosing to ignore it. For some mothers this meant choosing to raise their children as they were raised, by not taking protective actions against risks that they 'survived' in their own childhood. In some cases, where financial barriers prevented mothers from taking direct protective actions, this way of thinking could be a way to reduce cognitive dissonance (Festinger, 1957; McMaster & Lee, 1991). These findings highlight the challenges of risk communication and point to the need to present risk information in a way that ensures that it does not overwhelm and does not present information about risks that are beyond an individual's ability to address. Findings here indicate that scare tactics should be avoided, and that information about risks should be accompanied by recommendations for simple, affordable solutions as much as possible.

Another potential form of emotion focused coping identified in the interviews was the reliance on location to reduce perceptions of exposure. For rural respondents, this meant comparing themselves more favourably to those living in the city, despite identified concerns about rural risks such as pesticide exposure or oil spills. If they lived in the city, it meant

comparing themselves more favourably to those living downtown or in other urban areas, such as the GTA. Similarly, in Bickerstaff's (2004) review of the literature on risk perceptions of outdoor air pollution, individuals were often reluctant to accept that pollution was higher in their neighbourhood than elsewhere. However, our findings differ somewhat from some of Bickerstaff's findings, including that when respondents were aware of higher pollution in their area, they did not deny their exposure, but rather their *vulnerability to adverse health outcomes*. While it may be true that some environmental health risks can differ depending on location, particularly in the case of outdoor exposures, risks in household products and foods are likely to be similar regardless of whether one lives in an urban or rural area. Thus, the idea that living in one area rather than another automatically makes some people less at risk overall, or that there is always someone more at risk than oneself, may pose a challenge for effective risk communication.

While the Internet was the most common information source for most mothers, many expressed mistrust in it and felt the need to cross-reference sources to find reliable information. Many of the women felt that they would have been most receptive to receiving information about environmental health risks during their pregnancy, as they would not have been sufficiently concerned before becoming pregnant or have as much time to make changes after giving birth. Receiving information during the early stages of pregnancy is particularly important, given the vulnerability of the fetus and the critical stages of development that occur during that time (CPCHE, 2005; Schlotz & Phillips, 2009). Thus, awareness of risks during pregnancy, particularly near the beginning, allows for protective actions to be taken as early as possible. Ideally, information would be provided pre-conception to ensure that protective action could be taken immediately once a woman

becomes pregnant, while the fetus is most vulnerable. However, this could present a public health challenge, as informing women prior to or early during unplanned pregnancies could prove difficult. Overwhelmingly, participants felt that they would have preferred to receive environmental health risk information from a healthcare professional, yet none received information beyond basic baby care and general health (e.g. diet, smoking, and alcohol avoidance) during their prenatal appointments. This finding is supported by our previous research (Chapter 2), where only 8% reported receiving information about environmental health risks from healthcare professionals or public health. This suggests that changes should be made to public health programs and risk communication strategies in this population so that healthcare professionals provide environmental health risk information to mothers, ideally during their initial prenatal checkups.

This study has some limitations that should be outlined. First, it is possible that there was self-selection bias in that the women who agreed to participate in the interviews may possess certain characteristics or knowledge, and mothers who face temporal barriers may have been excluded if they did not have time to participate. As the interviews were only conducted in English or French, women who face linguistic barriers may also have been underrepresented. Finally, it is possible that the interviewer's position as a researcher may have influenced the interactions, although this was hopefully minimized by the fact that many of the interviews took place in the participants' homes. The fact that the interviewer was not a mother was only mentioned by one participant and likely affected the interviews less than if they had been conducted by a male researcher.

3.6 Conclusion

The purpose of this study was to better understand the perceptions and protective actions of mothers related to environmental health risks to their children, recognizing that mothers are often primary caregivers and children are more vulnerable to such risks than adults. Using semi-structured, face-to-face interviews, this research examined mothers' concerns, protective actions, barriers to taking action, coping strategies, and information sources in depth. While the levels and types of concern varied across the sample, there was a prevailing sense that mothers should be concerned enough to motivate taking some protective actions, but not so much as to cause excessive worry or be considered 'paranoid' or 'crazy'. The types and levels of protective actions taken also varied, but many mothers faced barriers to taking protective action at least some of the time, including financial barriers and risks being beyond their control. When protective actions could not be taken (problem focused coping), many mothers may have relied instead on emotion focused coping such as choosing to ignore risk information, not taking protective actions against risks that they 'survived' in their own childhood, and reasoning that where they live is inherently safer than another area. It is likely that sources and timing of information are important factors influencing levels of concern and protective actions. Most of the mothers relied on the Internet as their primary source of environmental health information, but they expressed mistrust in it and would have preferred to receive information from their healthcare providers, during their pregnancy.

This study contributes to the understanding of environmental health risk perceptions and protective actions in a largely understudied population. This understanding is important for the development of effective risk communication strategies and public health programs. The findings all point to the need for risk communication strategies that inform mothers without

overwhelming them, and that recommend simple and affordable solutions when possible. Further, environmental health education programs should be developed to inform women about environmental health risks as early as possible in a prenatal care context, so action can be taken to protect the fetus during critical stages of development.

Acknowledgements

The authors thank the staff at Peel Region and Ottawa Public Health Units for their support of this project and assistance with initial recruitment, as well as all of the mothers who participated in the study. There are no conflicts of interest to declare.

Funding

This research was supported by the Social Sciences and Humanities Research Council (SSHRC) Standard Research Grant [410-2009-0951], and the Ontario Graduate Scholarship (OGS) program.

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CHAPTER 4

Summary and Conclusions

4.1 Introduction

This research used a mixed-method approach to examine the ways new mothers in two Public Health Units in Ontario, Canada perceive environmental health risks to their children and the protective actions they may take to reduce them, and how these perceptions and actions may vary across socioeconomic and geographic contexts. This study was undertaken for several reasons. First, there is more information than ever before about day-to-day exposures to environmental health risks in our products, homes, and outdoor environments, which have been found to be associated with numerous poor health outcomes, both short and long-term. Second, children are more exposed and vulnerable than adults to environmental health hazards, and these risks can be expected to evoke concern in mothers, who are often primary caregivers, if they are made aware of them. Third, understanding the ways risks are perceived and negotiated is important for the development of effective, well-informed risk communication strategies and public health programs and policies. Finally, despite the fact that mothers tend to bear the primary responsibility for family health and decision-making, little is known about how they perceive and respond to risks. To begin addressing this gap in the literature, this study was guided by the following objectives:

1. Investigate new mothers' perceptions about environmental health risks to their children;
2. Examine their protective actions in response to perceived risks;
3. Determine the potential role of individual, socioeconomic, and geographic factors in affecting perceptions and protective actions; and,

4. Identify the main sources of environmental health risk information for new mothers, as well as preferences regarding sources and timing of access.

4.2 Summary of findings

4.2.1 Objective 1: Mothers' environmental health risk perceptions

This research demonstrated that mothers' perceptions of environmental health risks can vary widely, both in terms of levels and types of concerns. In the survey (Chapter 2), approximately half of the participants reported high or moderate levels of concern about environmental health risks. Of the hazards that they were aware of, the most commonly mentioned were household products (19%). Forty-six percent reported that they were not aware of any. Although the survey contributed to a broad understanding of levels and types of concerns within the group, the interviews (Chapter 3) allowed for these findings to be explored in more depth. Again, types of concerns varied widely and risk perceptions ranged from high concern and anxiety about environmental health risks for some, to virtually no concern for others. However, there was a prevailing sense that mothers should automatically become concerned about risks once they have children, yet not so concerned that they could be considered 'paranoid' or 'crazy'. Consistent with the expectation that women tend to be responsible for being primary caregivers and managers of family health, all of the mothers revealed that their partners were less concerned than themselves or not concerned at all about environmental health risks.

4.2.2 Objective 2: Mothers' protective actions

In the survey (Chapter 2), less than half of the mothers (43%) reported taking a high or moderate level of protective action, measured here as three or more action items. The most

commonly mentioned actions taken revolved around switching to safer household products, as could be expected given the relatively high awareness levels reported in association with these hazards. While less than half of the mothers in the survey group reported taking moderate or high levels of protective action, nearly all of the mothers reported taking multiple protective actions in the interviews (Chapter 3). Again, these actions often related to household products or food, and much less to outdoor risks. However, the interviews provided insight into the idea that protective action often involves compromise, consciously balancing taking some actions while not taking others. While taking protective action is a form of problem focused coping, the interviews allowed for emotion focused coping to be examined. It was found that the mothers sometimes chose to ignore risk information, did not take protective actions against risks that they 'survived' in their childhood, and relied on the belief that where they lived was inherently safer than elsewhere.

4.2.3 Objective 3: Determinants of risk perceptions and protective actions

The survey (Chapter 2) uncovered the inequities that exist where some individuals are more concerned and/or less able to take protective action. For example, women with lower income were more likely to be concerned about environmental health risks, while being less likely to take protective actions. A similar phenomenon has been found in other studies (Ho et al., 2005, Lee et al., 2005, Lemyre et al., 2006, Thoolen et al., 2008) and researchers argue that this reflects a lower sense of control in society that tends to be experienced by women than men. Correspondingly, women with the lowest level of perceived control were more likely to be concerned. Geography was a significant determinant of concern in the survey, where women living in Peel were more likely to be concerned about environmental health risks than women in Ottawa, yet no more likely to take protective action. Geographic factors

were reinforced in the interviews, where differences in risk perception existed between suburban and rural residents in Ottawa. Language was found to be another barrier to taking protective action, with women who did not speak English or French as a first language being much less likely to take multiple protective actions. The interviews (Chapter 3) were an opportunity for some of these inequities to be examined in more depth, particularly regarding control and financial resources. The mothers expressed that they were largely unable to take protective actions in response to outdoor risks, despite their concern, due to these risks being beyond individual control. They also discussed protective actions that they wanted to take but were unable to due to financial barriers (e.g. buying organic foods, switching to safer household products, moving to another area). These barriers identified by women in the interviews may help to explain the relatively low levels of protective action found in the survey. The research findings support the conceptual model presented in Chapter 1 as a way of illustrating the relationships that exist between risk perception, protective action, barriers and facilitators, as well as the individual, socioeconomic, and geographic contexts that may influence them.

4.2.4 Objective 4: Information sources

In the survey (Chapter 2), the Internet was the main information source for 58% of the respondents, and although only 8% relied primarily on healthcare providers or public health, they would have been the preferred source for 27% of the mothers. In the interviews (Chapter 3), the Internet was again the most commonly reported information source. However, the mothers felt that they could not always trust what they found there and that they needed to cross-reference information with other sources. Most felt that the best time for mothers to receive information about environmental health risks would be during

pregnancy, as such risks would be less likely to be of concern before becoming pregnant and there would be less time to learn about and address them after giving birth. Despite the fact that they did not receive information about environmental health risks from their healthcare providers, most of the mothers felt that they would be the best source of this type of information, which would ideally be provided during prenatal checkups.

4.3 Contributions of the study

4.3.1 Theoretical contributions

This research makes theoretical contributions to the literature on risk perception through the development of a new conceptual framework and through its focus on an important yet understudied population. The conceptual framework that was developed to inform the research takes a holistic approach to understanding risk perceptions, protective actions, and barriers, as they are influenced simultaneously by individual (e.g. age, gender), socioeconomic (e.g. income, education), and geographic (e.g. urban/rural, location) contexts. The findings largely supported the conceptual framework in that each of its major components was represented to some extent in the statistical models, with the exception of geographic context in relation to protective action. The influence of the major components, as well as barriers and corresponding emotion focused coping, were represented in the interview findings. While risk perception and behaviour theories have focused primarily on general populations, this research has adapted these theories to the context of new mothers, a specific population that has received limited attention in the risk literature. In addition to contributing to our understanding of risk perceptions and behaviours within this population, this research also examines issues of environmental justice by examining perceptions and

barriers to taking action across socioeconomic and geographic contexts. Further, most research that is ultimately conducted studies topics that are highly fundable, such as hazards or incidents that have received widespread media attention (Hawkes & Rowe, 2008). While much previous research has focused on *unavoidable* hazards, this study expands our understanding of perceptions and protective actions as they relate to hazards that are present in daily life and that are, in principal, *avoidable*, provided that the necessary resources are available.

4.3.2 Methodological contributions

This research makes methodological contributions to the field by using a mixed-method approach to better understand risk perception and protective action. While mixed-method approaches are increasingly recognized in health geography and in social science research more generally, they are less commonly seen in risk perception research. This approach minimizes the limitations of a single method approach by collecting quantitative survey data to uncover and examine broad, preliminary themes, followed by more in-depth, open-ended qualitative interview data in which emerging themes can be explored in more depth and the experiences, beliefs, and opinions of the participants can be expanded upon in their own words. This research also makes a methodological contribution through its unique approach to recruitment. With the help of the provincial program *Healthy Babies Healthy Children*, all mothers who had recently given birth were contacted and asked to participate, a sampling method that was likely more inclusive than, for example, snowball or convenience sampling.

4.3.3 Substantive contributions

Some of the most important potential contributions made by this research are substantive. According to Bickerstaff (2004), "recognising and accounting for the different

ways people understand and frame risk will be crucial to addressing issues of behaviour change and communication" (p. 836). By understanding how mothers in different geographic and socioeconomic contexts perceive environmental health risks and the factors that facilitate or hinder protective action, this research will help shape effective, population-specific risk communication strategies and public health programs and policies that are sensitive to different needs and contexts. Based on our findings, risk communication targeting new mothers should account for the ways they perceive, internalize, and respond to risk information and how these processes can vary based on income, language, location, and other factors. They should also aim to present information in an understandable and nonthreatening way, while providing recommendations for simple and affordable protective actions. Within our sample, mothers did not fully trust the information they accessed on the Internet and commonly reported a preference for having information come from healthcare professionals. As they typically did not receive this type of information from their doctors or nurses, educational public health programs could be developed to ensure that mothers receive basic information about environmental health risks and possible protective actions from a trusted source, during their pregnancy.

4.4 Limitations and directions for future research

This research is a first step towards building a strong foundation for understanding risk perceptions and protective actions among new mothers. However, there are some important limitations to this study that should be outlined. While the survey (Chapter 2) was administered to a relatively large sample, the quantitative data inevitably limited the ability to examine themes or individual experiences in much depth. However, the interviews

(Chapter 3) allowed for themes and experiences to be explored in much greater depth and in the participants' own words. It is possible that there was self-selection bias during recruitment, as the women who agreed to participate in the telephone survey or in the interviews are not likely representative of all mothers in the study areas, but rather those who have certain opinions, knowledge, or individual characteristics. For example, there is an overrepresentation of individuals with mid-to-high levels of income and education in the survey. Steps were taken to address this issue for the qualitative interviews by using a purposeful sampling approach that ensured that participants covered a broad range of income and education levels. Perhaps providing an honorarium as incentive for participation would have reduced the challenges associated with recruiting low-income participants. Further, while every effort was made to make this research as inclusive as possible, due to financial and time constraints the survey and interviews could only be conducted in English and French. Language is likely a key barrier to learning about environmental health risks and possible protective actions. In Peel region, for example, over 50% of the population immigrated to Canada and 54% of the population speaks a language other than English or French (Statistics Canada, 2011). Therefore, it can be expected that a potentially vulnerable group has not been adequately represented in this research and a key barrier has not been adequately explored. Finally, my position as a researcher, and not being a mother myself, may have limited the extent to which the mothers felt comfortable expressing all of their concerns and opinions during the interviews. Any researcher-researched tension that may have existed was hopefully minimized by the fact that most of the interviews were conducted in the mothers' homes. The issue of not being a mother came up once when a respondent said while answering a question that I would not understand because I am not a

mother. However, she was the only one to mention this, and as a young woman I likely faced fewer challenges than a male researcher might have.

While this research begins to fill some important gaps in our understanding of environmental health risk perceptions and behaviours in the context of new mothers, it also demonstrates that further research is required. Given the predominance of mid-to-high income respondents in these studies, future research should focus on better understanding the perceptions of low SES individuals as well, as they tend to face more exposure to environmental health hazards and more barriers to taking protective action. However, Bickerstaff (2004) cautions against generalizing findings across demographic groups without accounting for intra-group variation and suggests that future research should explore this heterogeneity. Future research targeting linguistic minorities would also be particularly relevant given the survey findings related to language barriers. Another interesting future research possibility would be a longitudinal study examining how perceptions and protective actions change as children age, become less vulnerable to environmental health hazards, and become more independent. Finally, despite the vulnerability of the fetus and young children to environmental health hazards, this study has found that new mothers do not receive information about environmental health risks from healthcare professionals during or even after their pregnancy. Thus, future research should examine the knowledge, attitudes, and practices of healthcare providers related to these types of hazards to inform the development of educational strategies and resources that improve pregnant women's access to information from a trustworthy source.

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APPENDIX 1

Survey questionnaire for new mothers

Good [morning/afternoon/evening]. I'm calling on behalf of [Ottawa/Peel] Public Health and the University of Ottawa from EKOS Research. I wish to speak with _____.

During a call from a(n) [Ottawa/Peel] Public Health nurse following the recent birth of your child, you agreed to be contacted to participate in a short survey on how you perceive the relationships between our environment and children's health. You should also have received a letter in the mail with details about the study. The goal of our study is to better understand your views on environment and health issues in your neighbourhood and home so we can provide better information and services to new parents. Your decision to participate is voluntary and will in no way affect the care you and your family receive from [Ottawa/Peel Region] Public Health. You may refuse to answer any question or stop at any time. The questionnaire should take about 20 minutes.

Before we begin, I need to tell you that I will be asking you some personal health questions. We work under laws guiding privacy when collecting, using and disclosing information. Only those involved in conducting and analyzing the survey will see this information. Your personal health information will be kept confidential except when: You say you may hurt yourself or others; we receive a court order; we suspect children are in need of protection; or in cases of mandatory disease reporting. Are you willing to participate?

Screening Questions

- Firstly, do you live in the [Ottawa region/Peel (i.e. Mississauga, Caledon or Brampton)] region?
- As this survey is about mothers and their new born children, could you confirm that you gave birth within the past year?

Neighbourhood

1. We would like to ask a few questions about your neighbourhood and community. Firstly, how long have you lived in your current neighbourhood?

2. What is one thing you LIKE most about your neighbourhood? Anything else you like?

3. What is one thing you DON'T LIKE about your neighbourhood? Anything else you don't like

4. Generally speaking, how satisfied are you with your neighbourhood as a place to live?

5. Would you tell me if you have been involved in any of the following local activities in the previous two years:
    a. Neighbourhood meetings
    b. Spoken or written to an official about some local issue

c. Community holiday celebrations
d. Annual neighbourhood cleanup
e. Worked with others in your community to do something about a community problem
f. Other

6. How often do you help or ask for help from your neighbours for such things as borrowing tools or food, or helping with each other's children, home repairs etc.?
    a. Never
    b. Once a year
    c. 1 or 2 times a month
    d. 1 or 2 times a week
    e. Daily
    f. Don't know neighbours

7. Do you have someone among your friends or family who can help you with everyday emergencies if you need it?

8. Do you have someone in your family or a close friend who you can confide in or talk freely to about your problems (personal, family, work, etc.)?

Family health

9. We would like to now ask a few questions about your family and your family's health. Firstly, how old is your new baby?

10. Is this your first child?

    a. If no: How many other children have you had?

11. How would you rate the health of your new baby(ies)?
    a. Excellent
    b. Very good
    c. Good
    d. Fair
    e. Poor

12. Does your new baby have any specific health conditions or problems that you are aware of?
    a. If yes: Could you please tell me what those health conditions are?
       Has this been identified by a doctor?

13. Does anyone else in your immediate family (i.e. you, your partner or other children) have any specific health conditions or problems that you are aware of?
    a. If yes: Could you please tell me what those health conditions are?
       Who in your family has this condition?
       Has this been diagnosed by a doctor?

Mother's health

14. Now I have a few questions specifically about YOUR health and well-being. Firstly, how would you rate your health compared to other people who have recently given birth?
    a. Excellent
    b. Very good
    c. Good
    d. Fair
    e. Poor

15. For the following series of questions, please indicate the degree to which each statement has applied to you recently, that is, in the last 4 or 5 days. Please respond on a scale between 1 and 8, where 1 equals 'not at all', and 8 equals 'extremely'.
    a. I feel calm
    b. I feel rushed, I do not seem to have enough time
    c. I have physical aches and pains: sore back, headache, stiff neck, stomach ache
    d. I feel preoccupied, tormented, or worried
    e. I feel confused, my thoughts are muddled; I lack concentration; I cannot focus
    f. I feel full of energy and keen
    g. I feel a great weight on my shoulders
    h. I have difficulty controlling my reactions, emotions, moods or gestures
    i. I feel stressed

Environmental health

16. Now we would like to ask a few questions regarding the relationship between health and the environment. Firstly, we would like to know a little bit more about your home environment. That is, in your opinion, is there anything in your home (i.e. indoor) environment such as the air, water or consumer products that you think may have affected your new baby's health when you were pregnant, or may be affecting it now?
    a. If yes: How do you think your baby's health may have been affected?
       Has this condition been identified by a doctor?
       About this, would you say that you are:
        i. Very concerned
        ii. Moderately concerned
        iii. Slightly concerned
        iv. Not concerned

17. How about your neighbourhood environment? That is, in your opinion, is there anything in your neighbourhood (outdoor) environment's air, water or soil that you think may have affected your baby's health when you were pregnant, or may be affecting it now?
    a. If yes: How do you think your baby's health may have been affected?
       Has this condition been identified by a doctor?
       About this, would you say that you are:
        i. Very concerned
        ii. Moderately concerned

iii. Slightly concerned
iv. Not concerned

18. Were you working at a job outside of your home or going to school when you were pregnant?

19. If yes: Was there anything about your work/school environment that you think may have affected your baby's health when you were pregnant?
    a. If yes: How do you think your baby's health may have been affected?
       Has this condition been identified by a doctor?
       About this, would you say that you are:
       i. Very concerned
       ii. Moderately concerned
       iii. Slightly concerned
       iv. Not concerned

20. Thinking about environmental hazards generally including contaminants, toxins or chemicals in the air, water, or consumer products - whether indoors, outdoors, in food or in any products you may buy - how concerned are you that they may be harming your baby's health?
    a. Very concerned
    b. Moderately concerned
    c. Slightly concerned
    d. Not concerned

21. Does anyone else in your immediate family including yourself have health problems that you would consider to be related to environmental hazards?
    a. If yes: Could you please tell me what those health conditions are?
       Who in your family has this condition?
       Has this condition been identified by a doctor?
       What environmental hazard(s) do you think this might be related to?
       About this would you say that you are:
       i. Very concerned
       ii. Moderately concerned
       iii. Slightly concerned
       iv. Not concerned

22. Were there any products – specific or types – that you STOPPED using, either during pregnancy or after giving birth, because you were concerned of how they might be harmful to your baby's health?

23. Were there any products – specific or types – that you STARTED using, either during pregnancy or after giving birth, because you felt they would be safer or healthier products to use around/on your baby?

24. Were you concerned enough about any environmental hazard during pregnancy or after giving birth to take specific precautions in or around your home, or at work, in order to protect your baby?

25. Were there any precautions that you wanted to take but were unable to?
    a. If yes: What prevented you from taking these precautions?

26. I am now going to read a series of statements and I would like you to tell me your level of agreement (strongly agree, somewhat agree, somewhat disagree, strongly disagree)
    a. The main thing that determines my exposure to environmental health risks is what I myself do.
    b. I have very little control over environmental risks to my health.
    c. My level of awareness and knowledge about environmental health hazards has increased since having children.
    d. My level of concern about environmental health hazards has increased since having children.
    e. There are steps I can take to protect my children from contaminants, toxins, or chemicals in the environment that might harm their health.
    f. I have received enough information about environmental health risks since getting pregnant to make safe choices for myself and my baby.

27. I now have a few questions about your sources of information. We are coming to the end of the survey. Did you hear or read about any environmental hazards that could affect your baby's health when you were pregnant or since having your baby?
    a. If yes: Where did you hear about these hazards?

28. Generally speaking, what have been your most common sources of information about environmental health risks to children since getting pregnant with your new baby(ies)?

29. Do you have access to the internet at home?

30. Do you regularly read the newspaper either on-line or hard copy (i.e. 3 or more times per week)?

31. Which newspaper?

32. Are there any environmental health issues that, as a new mother, you would like to have more information about?

33. What do you think would be the best way for pregnant women or new moms to access or receive information about environmental health risks?

Demographic questions

The last questions I would like to ask are about who you are. Please be assured that this information will be kept confidential and will only be used for statistical purposes.

- In what year were you born?
- Were you born in Canada?
    - If no: In what year did you come to Canada?
- Other than Canadian, to which ethnic or cultural group(s) do your ancestors belong?

- What is the language you first learned as a child and still understand?
- Do you consider yourself to belong to any of the following groups?
    - A member of a visible minority
    - An Aboriginal person
    - A disabled person
- What is your current marital status?
- How many adults and children live in your household?
- What is the highest level of schooling that you have completed?
- Do you rent or own your home?
- Which of the following best describes the combined annual income of all persons in your household, before taxes?
    - Under $20,000
    - $20,000 to just under $40,000
    - $40,000 to just under $60,000
    - $60,000 to just under $80,000
    - $80,000 to just under $100,000
    - $100,000 to just under $120,000
    - $120,000 and above
- Are you and your family always able to make ends meet (i.e. get by financially)?

Final questions

- Do you have any additional comments about any of the topics we have covered today?
- We are asking people who participated in this survey if they would you be willing to be contacted at a later date to discuss some of these ideas in more detail? Regardless of how you answered the questions in this survey, your ideas and opinions are very important to us. Even if you agree now, you can change your mind at any time. Your choice to participate further is entirely voluntary but would be very valuable to the study. May we contact you at a later date?

We have come to the end of the survey. Thank you very much for your time and patience.

If you would like more information about environmental health hazards and their potential impact on health I have a number you can call. Would you like that number?

Franca Ursitti, Peel Region Public Health, 905-791-7800 ext. 2712

OR

Ottawa Public Health, 613-580-6744 ext. 15414

If you wish to learn more about the study please contact Dr. Eric Crighton at the University of Ottawa at 613-562-5800 ext. 1065 or visit the following web site: http://www.ehri.uottawa.ca

APPENDIX 2

Interview guide for new mothers

I am a researcher from the University of Ottawa studying mothers' views on environment and health issues in Ontario. I am interested to learn about your opinions and experiences so I can gain a deeper understanding of the findings from the telephone survey you participated in. I really appreciate you taking the time to talk to me and contributing to this research.

Today's interview should take about 30 minutes. If you agree, I would like to record the interview to ensure that I accurately document your views. Are you still willing to participate? Do you have any questions before we begin?

Topic	Questions	Probes
First, I'd like to ask a few questions about your family and where you live.		
Introduction	How is your youngest child doing? Other children?	- Good health? - How old? - Tell me a little bit about him/her? - First child?
	Do you have a partner? Could you tell me a little bit about him/her? Who else plays a role in looking after your child(ren)?	- Typical roles/responsibilities around the house? Who cooks? Cleans? Shops? Takes care of child(ren)? - Other family nearby? Involved?
	Could you tell me a little bit about your home? Your neighbourhood?	- How long have you lived here? - Where did you live before? - Likes and dislikes? - Nearby schools? Parks? Stores? - Community involvement?
Next I would like to discuss some environmental health issues.		
Health and environment	If I mention the idea of environmental health risks, what comes to mind?	- Risks indoors? Outdoors? In products? In food? - Specific to children?
	Do you have any concerns about your home environment that you think may pose a threat to you or your child(ren) that you could tell me about? Daycare? Outdoor Environment? Everyday products?	- Any particular concerns? - Affecting your health? - Child(ren)'s health? - Partner concerned?
	How do you deal with these concerns?	- Taken/considered taking action to minimize risk? - Indoor, outdoor, products? - Anything preventing you from taking action? (time, money, resources)
	Who do you feel is responsible for the environmental health concerns you have raised? What are they doing about it?	- Doing enough? - Trust the people responsible?

Now I would like to ask a few questions about what kind of information, if any, you may hear about environmental health risks.		
Environmental risk information	Where would any information you might get about environmental health risks typically come from?	- Ob/gyn, public health, Internet, newspapers, TV, pregnancy/parenting books, prenatal classes, family/friends, other? - Most trusted source of info? - If you had questions, would you look for answers? Where?
	Do you think that you have the information you need to make informed choices to protect your child(ren)'s health?	- What more do you need? - Info easy to access/understand? - Barriers to accessing info? Language? - Solutions provided? Feasible? (time, money, access, priority)
	Have your attitudes about environmental health risks changed since having child(ren)?	- How so? Aware of them before? What kinds? - When have you been most concerned about environmental health risks? Before, during, after pregnancy? Now? Explain
	When do you think would be the best time for women to receive information about environmental health risks?	- Before, during, after pregnancy? - From what source(s)?
Now I'd like to ask you a few questions about a concept called environmental inequity. Environmental inequity is the idea that some groups of people are more exposed to environmental health risks because of their social or economic status, their race, or where they live.		
Environmental Inequity	Do you think this concept or any of these factors apply to you? Explain	- Income, education, housing, cultural background, ethnicity, location - Affect exposures? Awareness? Ability to take action/barriers?
	Do you think that your child(ren) has been/is more likely to be exposed to environmental hazards? At greater risk than other children? Explain	- Particular groups more affected than others? Why? Location? SES? Housing/daycare/school conditions? Access to information? Language barriers?
I have a few final questions for you:		
Respondent background	Finally I would just like to ask a couple of questions about you.	- Education, employment, age, culture, household income - Where were you born? How long in Canada/neighbourhood?

Conclusion:

That is all of the questions I have for you. Is there anything else you would like to discuss?

Thank you very much for your time. The information you have provided is very important and will go a long way in helping us better understand environmental health issues in the area.

If you have any questions about this study, you can contact me directly or visit the project website. The website has numerous links if you are interested in getting more information about environmental health issues. A final report and publications from this study will also be posted on this site.